FLIGHT

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The bold and effective Coloured Poster for the Nice Aviation Meeting, to be held from April 10th to 25th.

THE GOVERNMENT FLIGHT OFFICE.

REPORT OF THE NATIONAL PHYSICAL LABORATORY FOR 1909.

As our readers are aware, from particulars that have appeared in FLIGHT, notably Vol. I, pages 289, 489, the National Physical Laboratory at Teddington is actively engaged in experimental research in aeronautics and aviation on behalf of the Government. It was only last May that the Prime Minister made his announcement in the House of Commons of the part that the Government intended to take by way of recognising this very important subject; while everyone remembers Mr. Haldane's very satisfactory recent speech concerning official doings and official intentions that we reported and commented upon in our issue of two weeks ago. Research work is necessarily very slow at Bushey House but it comes as welcome news that the authorities have already made a good beginning; and we are pleased to be able to publish herewith the following abstracts from the first official report that has emanated from there and that—needless to state—is as self-explanatory as it is interesting :—

An Aeronautical Division has been organised in the Engineering Department of the Laboratory. Mr. Bairstow, who for some time past had assisted in the wind pressure work, was put in general charge under Dr. Stanton, and a staff of assistants and skilled mechanics appointed.

An account of the researches proposed is given in Dr. Stanton's report. A building 80 ft. square has been erected to hold a whirling table, an air channel for resistance experiments has been built, and two steel towers for experiments in the open have been put up, by the permission of His Majesty the King, in the Park, just outside the Laboratory grounds. Apparatus which will be used for testing motors to 50-h.p. submitted in competition for a prize of £1,000 offered by Mr. Patrick Alexander, is being installed.

Meanwhile experience has shown that the space available in the Engineering Laboratory is insufficient for the work, and the Lords Commissioners of H.M. Treasury have intimated their readiness to place a sum of £3,000 in the estimates for 1910–11 to provide an extension.

Department of Engineering Research Work.

A. General Investigations.

The Effect of Wind Pressure on Structures (Dr. Stanton).—In accordance with the scheme of work stated in the Report for 1908, records have been taken during the past year of the maximum wind pressures indicated by two instruments, one connected to a single Dines tube 50 ft. from the ground, and the other to two similar tubes, at the same height, but distant about 40 ft. apart horizontally and connected together in parallel. On windy days the instruments were read two or three times a day. The mean of the results obtained show quite clearly that the maximum intensity of the wind in any gale very rarely reaches the same intensity at two points 40 ft. apart at the same instant. The mean of fifty observations gave a value of the pressure in the single tube approximately 11 per cent. greater than that registered by the tubes in parallel, so that the pressure in one of the tubes in parallel was, on the average, 22 per cent. below the pressure in the other, corresponding to a difference in the velocities of 11 per cent. This set of experiments came to a conclusion in June, as the site of the experimental wind tower was required for the experimental tank. A similar arrangement has been erected on the two 60 ft. towers recently constructed for the aeronautical experiments, and will be ready for use early in the coming year. In this case the tubes in parallel are 350 ft. apart.

On the Resistance of Plates and Models in a Uniform Current of Water (Dr. Stanton.)—The experimental channel for this work described in the Report for 1908 was completed in January, 1909, and the results of a series of experiments on the resistance of submerged plates and models were communicated to the Institution of Naval Architects in a paper read at the Spring Meeting in April. The chief advantages of the method are the rapidity with which the experiments can be made compared with that obtainable in a tank with a moving carriage, and the simplicity of the arrangement for measuring the resultant pressure on the plate or model in any required direction. For this purpose the spindle to which the plate or model is attached passes through, and is perpendicular to, the knife edge of the weighing beam, so that by arranging the whole weighing mechanism to rotate about the centre of the spindle as an axis, the resultant pressure on the model in any direction is at once obtained by setting the knife edge of the weighing beam perpendicular to this direction.

The method of estimating the velocity of the current is by a measurement of the excess of pressure in a Pitot tube facing the current over that in a small orifice drilled in the side of the channel at the same height as the Pitot tube. The disturbances of the water entering the channel are corrected by layers of wire gauze, and the surface waves are damped by horizontal plates, which are adjusted to the correct height by screws in the supporting plate.

The results of the experiments on normal pressures on inclined plates were found to exhibit precisely the same characteristics as those which are obtained in air currents with the same form of plate, and were in substantial agreement with the results of previous experimenters using plates of considerably greater dimensions in water. By placing fixed models in front of the plates, to represent the action of the stern of a ship, very considerable reductions in the normal pressure were observed.

Experiments were also made on parallel plates at small inclinations to the current in order to investigate the interference of propeller blades with each other. An interesting fact brought out in these observations was the marked effect of one plate on another directly behind it. Thus, in the case of two plates inclined at 6° to the current in which the aft plate was completely screened, the reduction in the normal pressure on the latter was still considerable, even when the forward plate was nine lengths in front of it.

Observations on submerged solids of revolution showed clearly the marked effect of the fineness of the stern on the resistance. As an example of this, in the case of three models of precisely the same form of bow and middle, but with sterns in the form of cones of angles 6°, 10° and 20°, the resistances were as 1 : 1·15 : 1·95, or per unit of volume as 1 : 1·9 : 4·8.

B. Aeronautics.

(Dr. Stanton, Mr. Bairstow, Mr. Booth, Mr. Rowell and Mr. Hyde.)

In accordance with the scheme of research work to be undertaken in the Engineering Department, which has been approved by the Advisory Committee for Aeronautics, the following researches have been commenced :—

1. The determination of the resistance of plates and models in an experimental wind channel.
2. The resistance of large sized plates and models mounted on steel towers in the open and exposed to the action of the wind.
3. Experiments on the efficiency of air propellers on a whirling table.
4. Tests on the efficiency and endurance of petrol motors for aeronautical work.
5. Tests on the strength and elasticity of fabrics for balloons and airships.

The progress of these researches up to the end of 1909 was as follows :—

1. Experimental Wind Channel.—For the experiments on models in a uniform current of air, a horizontal channel 4 ft. by 4 ft. in section and 20 ft. long has been constructed. The channel is supported in the centre of a similar channel 8 ft. by 8 ft. in section, so that the air drawn through the 4 ft. channel can be returned through the space between the channels and used again. The method of producing the flow is by using a 6 ft. Sirocco fan, belt driven from a 15-h.p. dynamo, and making about 150 revolutions per minute. The fan is so arranged that the inner channel in which the experiments are made is the suction pipe of the fan, as experience shows that this is the most favourable position for steady air flow.

In the experiments the model is attached to one end of a lever which projects into the channel, and which is supported by a cross-head attached to a bracket outside the channel. The suspension of the lever and cross-head is such that the motion of the lever may take place about either a horizontal or vertical axis. The other side of the lever is utilised as a weigh-beam for vertical forces on the model, and there is an auxiliary weigh-beam at the exterior end to measure horizontal forces. In this way the horizontal and vertical forces on the model, *e.g.*, the drift and lift of an inclined plane, can be measured at one setting. Provision is also made for rotating the model about a horizontal axis without stopping the current, which will save time in observations on inclined planes. The lever is provided with an oil dash-pot to damp out oscillations either horizontally or vertically.

For the estimation of the velocity of the current the combination of Pitot tube and static pressure tube used in the previous experiments on air resistance has been adopted, the pressure being measured on a sensitive gauge containing castor oil and water.

In the preliminary trials of the apparatus considerable difficulties were encountered owing to the fluctuations of pressure which took place in the channel. These fluctuations had a period of about 10 seconds, and on investigation appeared to be due to the constriction and sudden enlargement of the return channel at the outlet of the fan chamber. On fitting a large number of guide blades and making the sectional area of the outlet gradually diverging, the fluctuations of the static pressure in the inner channel were practically destroyed, but there was still a good deal of variation in the velocity of the current; steps are being taken to remedy this.

2. The Experimental Wind Towers.—For the purpose of the experiments on the action of the wind on large scale models, the use of a strip of ground about 150 yards long and 12 yards broad on the west side of the Laboratory grounds has been granted by the Office of Works. This site is practically the only one in the vicinity which is suitable for the purpose; from this point, in the direction from which the most prevalent winds blow, there is open ground, free from trees and other obstructions, for about 600 yards. On this strip two steel towers, each 60 ft. high, have been erected. On the top of each tower there is a rotating platform 20 ft. long by 3 ft. wide, so that it will be possible to gain access to plates and models of fairly large areas when exposed to the wind. The upper 40 ft. of the towers is parallel, 8 ft. by 8 ft. in section, and this expands to 12 ft. by 12 ft. at the foundations. There is a platform every 10 ft., which is reached by a ladder inside the main framework from the platform below, so that access to all parts of the towers is easy. The two towers are 110 yards apart, and an observation hut has been erected half-way between them. For observations on intensity of pressure a number of lead pipes have been carried up to the top of the towers, and are brought along the ground in an earthenware channel to the hut in which the pressure recorders are to be placed.

3. The Whirling Table.—For the whirling table of 60 ft. diameter, which has been designed chiefly for making tests on model propellers, a special corrugated iron building has been erected on the east side of the main block of the Engineering Department. It was considered that a clearance of 10 ft. between the walls and the end of the long arm of the table would be sufficient to prevent any disturbance from the walls, so that the floor of the building was made 80 ft. by 80 ft. The clear space in which the table will revolve is 80 ft. by 80 ft. by 12 ft., with the exception of a small observation desk in one corner. The table is attached to a vertical shaft mounted in ball-bearings in the centre of the room, and driven through a worm gear by a variable speed electrical motor of 14 b.h.p. By this means the velocity of the models can be varied from 25 to 100 ft. per second. The arms of the table are made of double lengths of thin steel tubing, tapering in steps from $1\frac{1}{2}$ ins. at the axis to 1 in. at the ends, with horizontal struts at intervals of 6 ft., and supported by steel wire ties to the centre post. For driving the propellers a light high-speed motor will be mounted on the rotating arm, and provided with a speed regulator worked from the observation table. The arm opposite to that carrying the models is only 10 ft. long, and carries a weight to balance the whole arrangement.

4. Motor-Testing Plant.—For the tests on the efficiency and endurance of petrol motors, machined cast-iron rails have been let into the floor of the experimental bay. These are provided with adjustable cross rails so as to accommodate any size of motor. For the absorption and measurement of the power a 10-h.p. dynamo has been fitted into a cradle which is suspended on knife edges, with a lever and balance-weights for measuring the torque. The balance-weights rest on a vertical spindle, which works in an oil dash-pot at its lower end to damp out any oscillations that may be set up. The energy from the dynamo is dissipated on special resistance mats, which are so arranged that by means of switches any required power can be absorbed.

5. The Testing of the Strength and Elasticity of Fabrics for Balloons and Airships.—Several sets of tensile tests on fabrics have been carried out during the year. The method of test has been to suspend the upper grips from a crane hook, and load the lower grips by dead weights added in equal increments until fracture occurs. To enable these tests to be carried out more rapidly a special testing machine has been ordered from Messrs. Avery, in which the load will be added by the well known shot method. An investigation is proceeding for the purpose of determining the best form of test specimen for these fabrics. Apparatus for making bursting tests has also been put in hand.

Department of Metallurgical Chemistry.

Aeronautics Division (Dr. Rosenhain, Mr. Barr).—This division has been established to carry out the chemical and allied work required in connection with the work of the Laboratory for the Advisory Committee for Aeronautics. The work principally contemplated at present is concerned with the testing of balloon and aeroplane fabrics, as well as such matters as the detection of hydrogen leakage from balloons, and similar problems. Work in connection with light alloys and other metals employed for aeronautical purposes will be undertaken by the Metallurgy Division.

In regard to the testing of balloon and aeroplane fabrics, a comprehensive scheme of tests has been drawn up and submitted to the Advisory Committee; the tests proposed include testing for leakage of hydrogen, with the influence of crumpling and folding on this property, uniformity of weight and thickness and occurrence of "pin holes," hygroscopicity and moisture-absorption, both from a damp atmosphere and an immersion in water, durability and weathering properties, including resistance to exposure to ultra-violet light, heat-transmission and inflammability, behaviour under extreme cold and allied properties. An apparatus for testing the leakage of hydrogen through such fabrics has been designed and constructed (with the aid of the Engineering Department), and has been in actual use for several weeks. The apparatus works on the principle of sending slow currents of pure dry air and pure dry hydrogen through two chambers separated by a diaphragm consisting of the fabric to be tested; after passing through this chamber the air is led through a heated combustion-tube packed with platinised silica, and the water formed is weighed after absorption in a calcium-chloride tube. Although the actual rates of leakage are very low (as little as 2·5 litres per square metre of fabric per 24 hours) they can be readily detected and measured by this apparatus, and perfectly steady results are obtained so long as the temperature remains constant; the rate of diffusion, however, increases rapidly with rising temperature, and the temperature-coefficient will be determined early in the year. This type of apparatus, it may be mentioned, possesses the very considerable advantage that the hydrogen to be determined is weighed in the form of water, which weighs nine times as much as the hydrogen it contains, and the results given by the apparatus are practically independent of the gas-tightness of the instrument itself, so long as there is no large leakage at any point. The entire apparatus is arranged to regulate itself in an automatic manner—the hydrogen, for instance, being produced by an electrolytic generator which cuts off the curreut if the pressure of hydrogen rises beyond the desired amount—so that very little actual attention is required except in inserting the fabric, and at intervals of several hours, taking the weight of the absorption bulb.

For the purpose of testing the behaviour of fabrics under ultra-violet light, a special chamber has been designed and is now under construction, while arrangements for carrying out the other tests mentioned above are in active preparation.

Library (Mr. Selby).

In connection with the work carried out at the Laboratory for the Advisory Committee for Aeronautics, a collection of works and publications relating to aeronautics is being formed. It would be of interest that this should be made as complete as possible, and gifts of old periodicals and books dealing with the subject would be welcomed.

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Territorial Balloonists.

IN reply to a question in the House of Commons last week. Mr. Haldane, the Secretary for War, said that the Territorial Balloon Company is not yet equipped for mobilisation. The future organisation of the Regular Balloon Companies is at present under consideration, and the organisation of this company will depend on the decision arrived at. The Balloon Company forms part of Army troops, and is not allotted to any division on mobilisation.

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Entries for Nice Meeting.

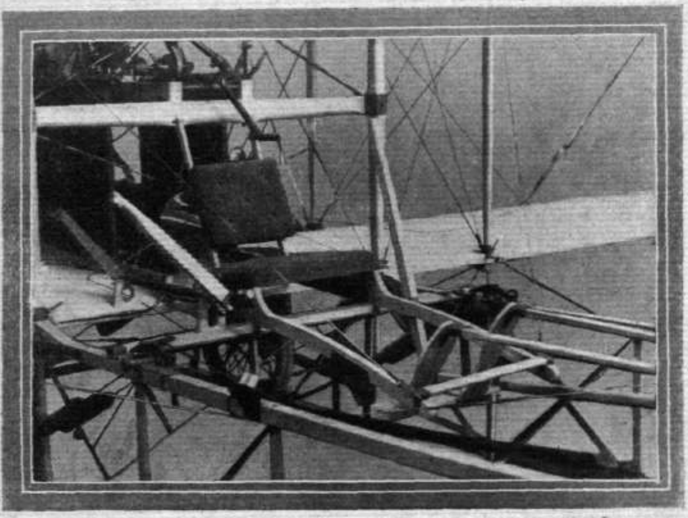
PRACTICALLY the opening aviation meeting of the year in France will be that at Nice, from April 12th to 24th, and this has attracted 14 entries, which are almost identical with those who were at Heliopolis. They include Rougier, Latham, Grade, Reimsdyck, Sands, Mortimer Singer, Van den Born, Métrot, Le Blon, Duray, Effimof, Chavez, Olieslagers, Swenson. The meeting will be held on the Napoule Racecourse, where Count Lambert taught several of the Wright pupils.

THE NEW "SHORT" BIPLANE.

(*Continued from page* 213.)

Short-Wright Comparisons.

ALTHOUGH there are some points in common between the Short machine and the Wright machines that are manufactured in England by Short Brothers, the design in general is entirely different. The rudder, for instance, in the Wright biplane is placed behind; in the Short biplane it is placed in front where it is situated immediately behind the elevator. The Short biplane, too, has a horizontal and a vertical tail, whereas the Wright flyer has nothing but its double rudder at the rear of the planes. These differences are, of course, of a fundamental character, and entirely outweigh such small features of similarity as may be noticed in the appearance of the decks. The system of control, too, is fundamentally dissimilar, inasmuch as the planes of the Short machine are rigid, whereas those of the Wright are capable of being warped. Lateral equilibrium in the Short biplane is maintained by the manipulation of a pair of independent balancing planes that are pivoted to the vertical struts at the extremities of the machine.



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View of the pilot's seat on the Short biplane. The lever on the pilot's right controls the balancing-planes, that on his left the elevator; the pedals control the rudder.

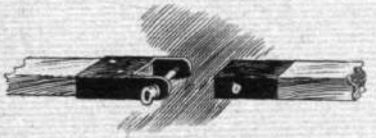
In detail, as in generalities, the Short biplane is most interesting, and it gives evidence everywhere of most careful and original thought in its construction, as will be shown by a glance at the accompanying illustrations and a perusal of the following brief description of the more characteristic features of the machine.

Main Planes.

The main planes are so erected that they can be dismantled in three sections and packed fore and aft into a width of 10 ft., the principal transverse spars are jointed on either side of the central portion that forms a permanent part of the chassis. The joint is a simple socket and the fastening is accomplished by a single bolt, the strain being, of course, taken off the joints by the diagonal wire bracing that converts the construction of the decks as a whole into a lattice box-girder. Between the main spars are placed the cambered ribs upon which the surfacing material is stretched. The planes are double surfaced, that is to say the fabric is applied to the upper and lower faces of the ribs.

The Leading Edge.

The front spar of each deck forms the leading edge and is quite blunt; in fact, it is only rounded off at the corners, no attempt whatever having been made to provide a sharp entry, Short Brothers having been led to the conclusion, as the result of their experience, that there is no practical advantage in such a refinement. This is, of course, a very interesting and important point, because not only is it common opinion that the entering edge should at least be well rounded, but many constructors have gone to the trouble of continuing the ribs beyond the front spar in order to provide a really sharp entering edge without reducing the section of that member. It has always seemed to us that while a sharp entering edge may be advantageous in theory, the difficulty is to ensure that the machine shall fly with that edge tangential to the relative wind, in other words we are of the opinion that while the sharp cutting edge is probably best in one particular position it is quite likely to be less efficient than a blunt edge in other positions than that for which it was designed. Information on the subject of the actual behaviour of the air in the vicinity of the leading edge is very limited, and it would be interesting to know whether there may not be some sort of piling-up action taking place in the air itself of such a character as to give a blunt leading edge an artificial sharpness that automatically adjusts itself to the attitude of the machine in flight. Whether or no there is any justification for any such view, or whether the actual



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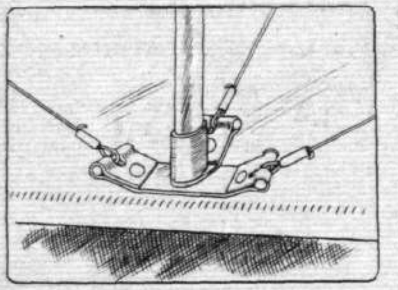
Sketch illustrating the jointing of the main spars on the Short biplane.



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Sketch illustrating the method of attaching the struts to the spars in the Short biplane. The manganese-steel socket-brackets are fixed to the spars and not to the struts.

differences in efficiency between the theoretical streamline section and the blunt edge are far less than have been supposed we do not know, but it is, at any rate, very interesting to find how little attention is bestowed to the sharpening of the edges of struts and spars in the Short biplane.

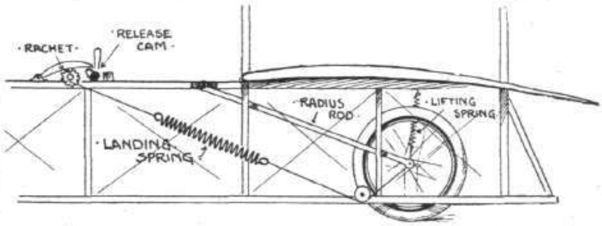
Struts and Ties.

The struts themselves, like the main spars, are made of spruce, and are rectangular in section. They taper from the centre towards each extremity in order to combine strength with lightness, and they are mounted in manganese-steel sockets. These sockets are attached to the spars and not to the struts; in fact, there is no metal fitting on the struts at all, and if a strut should be broken another can immediately replace it. Being in compression as the result of the tension of the diagonal tie-wires, the struts are automatically prevented from coming out of their sockets; moreover, with this system of construction something of the flexibility that characterises the Wright joint has been retained, without the complication of the hook and eye. The tie-wires on the Short machine are stronger than was formerly considered necessary, 10 and 12 S.W.G. being the gauge that is now employed, whereas 16 used to be considered heavy enough.

It is interesting to note that Short Brothers have come to the conclusion that wires offer less resistance than is popularly supposed to be the case. Some of our readers may remember that Esnault-Pelterie publicly stated how, after having tried a Wright type of glider of his own construction, he abandoned the biplane principle in favour of the monoplane system solely because of excessive head resistance caused by the wires necessary in biplane construction. He attributed this resistance to the vibration of the wire and seemed to be distinctly of opinion that a single wire had resistance equivalent to a rigid strut an inch or more in diameter.

Chassis and Suspension.

The chassis forms another example of the lattice box-girder type of construction, four spruce beams being trussed together by vertical struts and diagonal ties. The tie-members between the upper and lower beams on each side are formed by strip manganese-steel, while the cross-ties between the side-members are formed by piano wire. The lower beams form the skis on which the machine lands, but in conjunction therewith a set of wire wheels are also provided in order to enable the machine to run about on the ground for starting. Two of these wheels, which carry the greater part of the load, are so mounted that they can be raised out of action by a small lever near the pilot's seat, as soon as the machine is in flight,



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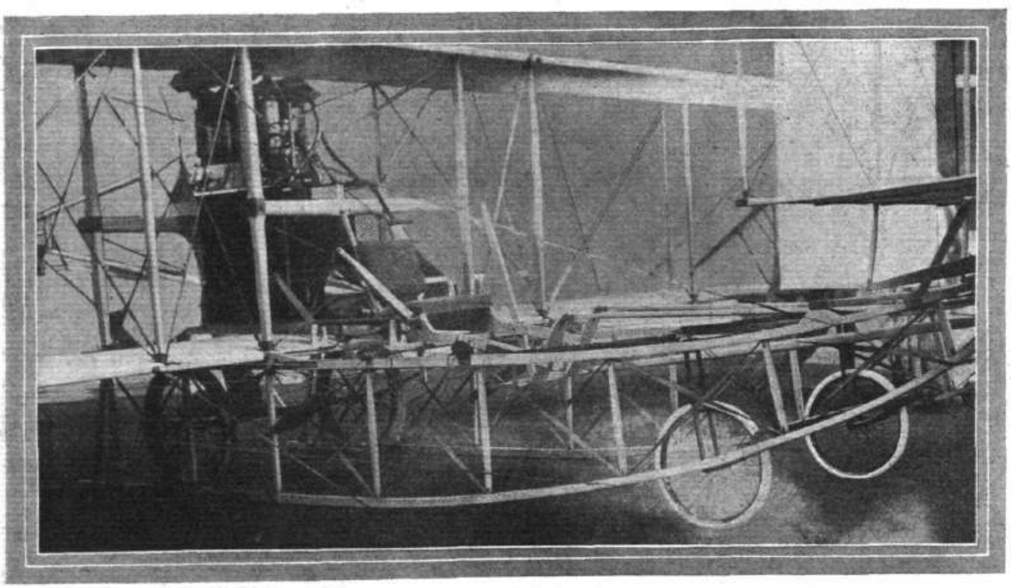
Diagrammatic sketch illustrating the suspension of the Short biplane, and the method of mounting the "disappearing" wheels so that the machine will land on the skis if the driver releases the ratchet pawl device by which the spring tension is maintained.

thereby relieving them of all shock when landing. This releases a set of supplementary springs, which raise the wheels out of action above the level of the skis. The forward wheels, which merely serve to support the weight of the elevator and rudder, are suspended by elastic, and thus offer very little resistance to shock.

(*To be concluded.*)



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View of the chassis on the Short biplane; the wheels are suspended on helical springs that are wound up by a ratchet-pawl device. The pilot releases a catch when he has ascended in the air and the wheels are drawn up above the level of the skis, upon which the machine therefore lands direct.

BRITISH FLIGHT ENGINES.

"THE GREEN."

(*Concluded from page* 215.)

The Carburettor.

THE carburettor is one of the special features of the Green engine, and is remarkable in having no float-feed chamber. Its construction is illustrated by an accompanying sectional drawing (Fig. 12). Petrol from the tank is delivered straight to the jet tube, but is prevented from overflowing by a spindle, the head of which normally closes the upper orifice of the jet tube. A very light spring holds the valve-like head of the jet-spindle down upon its seating. For the greater part of its length the jet-spindle is a close fit in the jet-tube, the only passage for the petrol being that provided by a shallow groove cut in the jet-spindle itself. This groove is gradually reduced in depth near the upper extremity of the jet-spindle, and ceases to exist altogether about one-eighth of an inch from the jet-spindle head.

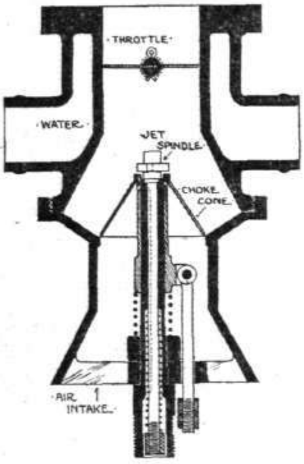

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Fig. 12.—Sectional drawing illustrating the construction of the Green carburettor.

Surrounding the jet-tube, upon which it makes a sliding fit, is a sleeve carrying a cone-shaped extension so arranged that it chokes the passage of the air intake. A light spring supports the weight of the choke-cone and its sleeve in such a position that the air intake is normally closed. Small perforations are made close to the upper extremity of the sleeve to which the choke-cone is fastened. These holes are normally covered by the jet-tube, and, being situated at different distances from the extremity, they uncover at different times if the sleeve is raised. The actual extremity of the sleeve is just clear, in its normal position, from a flange on the

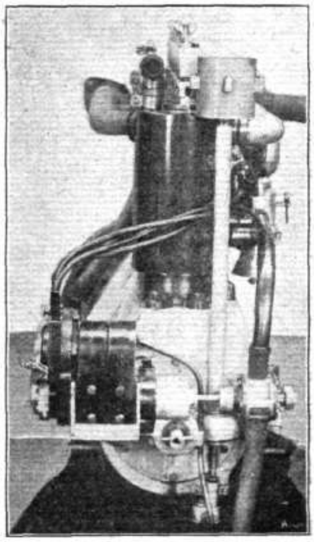

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Fig. 13.—End view of the Green engine, showing the position of the magneto, water-pump, and oil-pump.

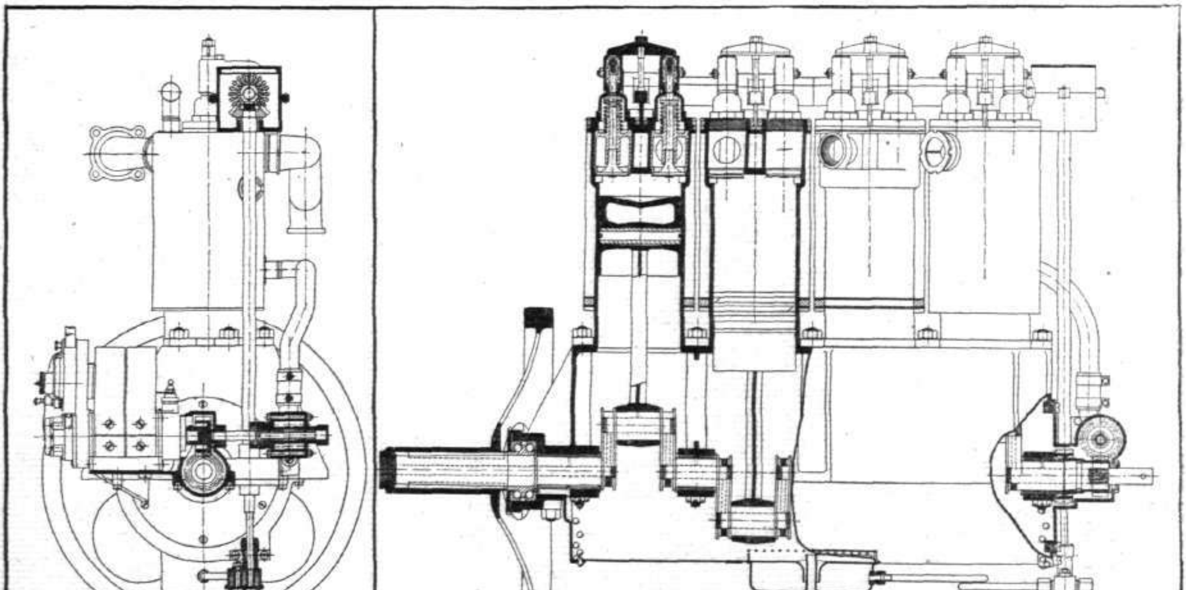

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Fig. 14.—Transverse section showing details in the arrangement of the magneto, water-pump, and oil-pump on the Green engine, together with sectional drawing, showing the construction and arrangement of the thrust-bearing on the end of the crank-shaft.

upper end of the jet-spindle; if the jet-sleeve is raised more than about one-sixteenth of an inch it touches the flange, and lifts the jet-spindle in the jet-tube. This uncovers the groove in the jet-spindle, and allows petrol to flow through into the cup-shaped pocket that is formed by the

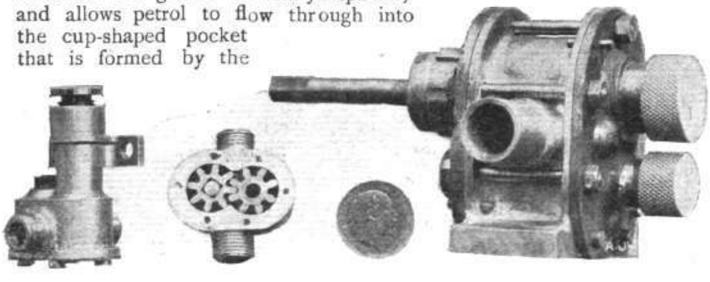

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Fig. 15.—Photograph illustrating the diminutive size of the oil-pump on the Green engine. It is shown alongside the water-pump, and a penny piece has been included in the photograph to give an idea of actual dimensions.

sleeve of the choke-cone. This sleeve is perforated, as we have already explained, and some of the air —which is assumed to be in motion under this condition—passes through the afore-mentioned holes, and carries away the petrol into the mixing-chamber as a fine spray. A passage past the flange on the upper end of the jet-spindle is provided by cutting a deep V notch in the flange itself.

The action of lifting the jet-spindle by the raising of the choke-cone sleeve results from the lifting effect of the air on the choke-cone itself. The opening of the throttle, and the starting up of the engine, produces a suction in

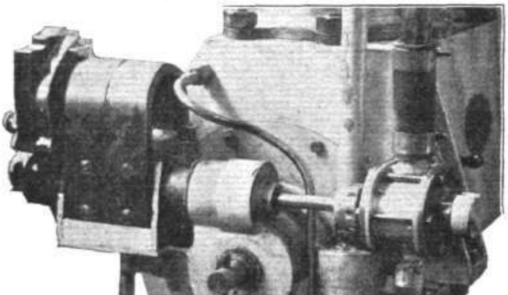

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Fig. 16.—Detailed view showing the magneto, water-pump, and oil-pump in place on the Green engine.

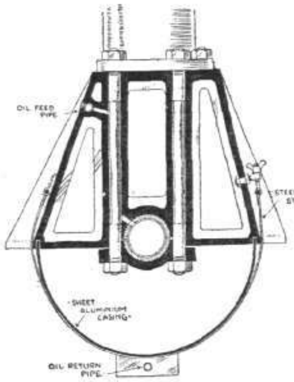
the mixing-chamber that causes a rush of air through the air intake. The air intake passage is restricted, as we have explained, consequently the immediate effect of the air trying to flow into the mixing-chamber is the raising of the choke-cone and the opening of the jet. Needless to say, considerable experiment has been necessary in order to so proportion the dimensions and relative movements of the different parts as to ensure a correct mixture throughout the full range of speed and load of which the engine is capable. For starting up, provision is made for positively opening the jet by hand, a rod being attached to the choke-cone sleeve for this purpose.

Lubrication.

Lubrication of the Green engine is accomplished by a very small gear-wheel pump (Fig. 13) that is driven by an extension of the vertical spindle used for driving the cam-shaft. The pump is attached to the end-plate of the base-chamber, and lies on a level with the oil sump. It delivers oil under pressure direct to a passage cast in the upper part of the crank-chamber, which passage communicates with each of the crank-shaft bearings (Fig. 17). Two minor details of interest in connection with the lubrication system are the method of casting the passage and the nature of the oil-way to the crank-shaft bearings.

The oil passage in the upper part of the crank-chamber is formed by a copper tube that is placed as a core in the mould when the crank-chamber is originally cast. The oil passages to the crank-shaft bearings are formed around the cylinder bolts by turning down the shanks of these bolts until their diameter is the same as that at the bottom of the thread. This gives the bolt a uniform strength throughout, saves a little weight, and affords a large clear oil passage that can very readily be cleaned out when necessary. The arrangement of these oil passages is very clearly shown in one of the accompanying drawings.

Entering the crank-shaft through a passage drilled through the journal, the oil finds its way to the crank-pins and there lubricates the big ends of the connecting-rods. Lubrication of the cylinders and gudgeons is provided for by the oil that is thrown out from the big ends as the crank-shaft revolves.



"Flight" Copyright.

Fig. 17.—Sectional sketch illustrating the oil-way to the crank-shaft bearings on the Green engine.

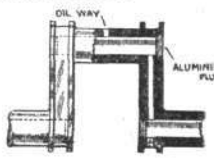


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Fig. 18. — Sectional sketch illustrating the oil-ways in the crank-shaft of the Green engine.

The other principal accessory fittings on the Green engine are the magneto and the water pump (Fig. 16). Both are driven by a transverse shaft that is skew-driven from the crank-shaft in the manner already described. A gear-wheel water pump has been adopted in preference to a pump of the centrifugal type, on account of the undecided character of the modern aeroplane radiator and the necessity of providing adequate pumping power to meet any emergency.

Propeller Fastening.

Provision has been made on the Green engine for the crank-shaft to be fitted either with a propeller or a tractor screw, a double-thrust bearing being the standard fitting on all engines (Fig. 11). The propeller is built up on a flanged sleeve that slides over the end of the crank-shaft and is driven by keys. The sleeve is held in place by a nut on the end of the crank-shaft, which forces the opposite extremity of the sleeve hard up against the aforementioned thrust bearing.

The inner ball-race against which this sleeve is thrust is itself loose on the shaft, but abuts against a solid collar. It carries two rows of balls on opposite sides of a simple thrust collar, and these balls run in ring races that are contained in a screw-capped box forming an extension of the crank-chamber casting. When the crank-shaft is fitted with a propeller the thrust is transmitted direct to the crank-chamber casting by the direct abutment of the propeller sleeve upon the thrust-bearing. When, on the other hand, the crank-shaft is fitted with a tractor screw, the pull is transmitted to the crank-shaft through the nut on its extremity, and is transferred thence to the screw cap on the thrust-box *via* the collar on the crank-shaft itself.

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AN AERODYNAMIC EXAMINATION PAPER.

WE have received from Mr. L. Blin Desbleds, lecturer in aeronautical engineering at the Northampton Institute and the Polytechnic, what we believe is the first examination paper ever set on aerodynamics. It forms part of the aero-engineering course at the Polytechnic School of Engineering, and by reason of its general interest we reproduce the entire series of questions below :—

INSTRUCTIONS.

(Only SIX of the following ten questions to be attempted.)

1. Define the term "co-efficient of influence of aspect ratio" of a plane rectangular surface. What, according to Soreau's formula, is the greatest value which that co-efficient may have? Can that value be attained in practice?

A plane surface, 24 metres span, and of depth 6 metres, moves in still air in a pterygoid aspect at a speed of 50 kilometres per hour at an inclination of 5°. Calculate the pressure of the air on the surface. [$K = 0{\cdot}07$ and $k = 3{\cdot}01$.]

2. If the area of the surface, referring to Lilienthal's table, be A square metres, and if it is moving at an inclination of 5° at a speed of v metres per second, calculate the *lift* and *drift* of the surface.

3. Explain briefly the "theory of equivalent plane surface" applied to curved surfaces.

4. Show, by means of sketches, how a low position of the centre of gravity of an aeroplane relatively to the centre of air pressure helps to maintain the lateral stability of an aeroplane when it is moving in a straight line, but tends to destroy that stability when the motion is along a curved path.

5. Comment on the following statement: "Of two aeroplanes which differ only in the outline of their sustaining surfaces, the one which has the worse 'sustaining quality' can be made to move with the greater speed."

6. Show, by means of diagrams, how the longitudinal stability of an aeroplane is affected by the relative positions of the centre of gravity, centre of pressure, and point of propeller thrust (or traction).

7. What is the "dynamical thrust" of a screw-propeller? What, according to Arnoux' experiments, is the relation between the dynamical thrust of a screw-propeller and its stationary thrust?

8. Explain why an aeroplane naturally falls a little when it takes a turning, and, also, in what way the unequal air-pressure, on an aeroplane's wings when it takes a turning, helps it to take that turning.

9. What, according to the experiments of the Aerodynamical Institute of Kutchino, is the direction of the pressure of the air on a plane surface moving at a small angle of inclination?

Prove that, if the air pressure is assumed to be perpendicular to a plane surface moving at a small angle of inclination, no serious error is introduced into the expression giving the *lift* of the surface; but that the expression for the *drift* may be seriously affected by the assumption.

10. Explain the following terms which have been used by Drzewiecki in his theory of aerial screw-propellers: "modulus," "normal blade," "specific width," and "reduction ratio."

A motor, of h.p. P, is driving a propeller at the rate of N revolutions per minute; if the pitch of the propeller is p feet and its slip per cent. is s, find an expression for the efficiency of the propeller, assuming that the resistance to the motion of the propelled apparatus is R lbs.

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PROGRESS OF FLIGHT ABOUT THE COUNTRY.

(NOTE.—Addresses, temporary or permanent, follow in each case the names of the clubs, where communications of our readers can be addressed direct to the Secretary. We would ask Club Secretaries in future to see that the notes regarding their Clubs reach the Editor of FLIGHT, 44, St. Martin's Lane, London, W.C., by 12 noon on Wednesday at latest.)

Birmingham Aero Club (165, HAMPTON STREET).

AN arrangement has been made between this club and the members of the Botanical Gardens, Edgbaston, to hold an exhibition of model aeroplanes, light petrol motors, &c., on Saturday, May 21st. There will be two petrol-driven model biplanes giving short flights. In addition, there will be flights of the ordinary elastic-driven models. Entries are invited from all parts. Prizes in cash will be given to the value of £30. Special prizes are offered for original designs.

Coventry Aeronautical Society (18 and 19, HERTFORD STREET).

ON Thursday March 10th, a second most interesting lecture was delivered before this Society by Mr. A. P. Thurston, B.Sc., on the subject of "Screw Propellers." The lecture was profusely illustrated with lantern slides of Sir Hiram Maxim's new machine, with which Mr. Thurston is interested, and also with a number of models of propellers which had been used for experimental purposes.

In connection with the above club, a lecture by Mr. F. W. Lanchester has been arranged for Thursday, April 14th, at the Corn Exchange, Smithford Street, Coventry, the subject of which will be announced later.

Dundee Aero Club (3, BALTIC STREET, DUNDEE).

THE club is making excellent progress, despite the lack of interest in aerial locomotion in this district.

A meeting was held in Lamb's Hotel, Dundee, on Wednesday, 16th inst., and a competition was arranged for models, to take place on 16th April. The chairman of the meeting, Mr. J. H. Stewart, kindly offered a prize to be competed for. It was decided that we should see about a suitable place at once.

Recent trials with models proved very satisfactory. One model, weighing 17 ozs., flew straight for 70 yards, and another of the same dimensions, but weighing only 12 ozs., flew 200 yards. We use plenty of elastic, with large propellers.

Kite and Model Aeroplane Assoc. (27, VICTORY RD., WIMBLEDON)

THE Council of this Association wish to call the attention of all model makers to the fact that a number of flying meetings will be held during the summer, in addition to the kite and gliding contests.

A special feature will be an open competition for model machines on new and scientific lines, as the rules will be drawn up on quite different lines to those generally followed.

The conditions will be finally settled at the next meeting, and will be sent out to members and those interested during the first or second week in April.

Gentlemen wishing to join should send in their names at once to the Hon. Sec. The subscription is 5*s.* per annum, and 2*s.* 6*d.* per annum for members under 17 years of age.

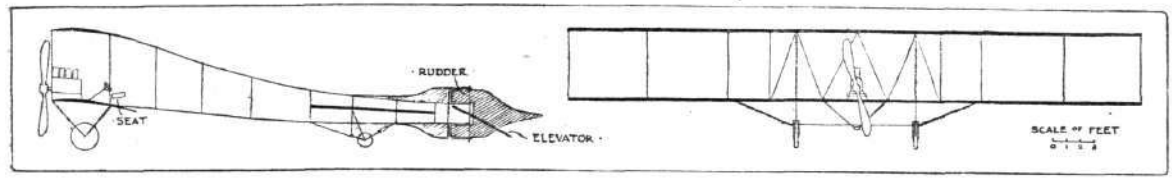
The Council also appeal to those interested to subscribe to the prize fund.

Midland Aero Club (GRAND HOTEL, BIRMINGHAM).

AT the meeting at headquarters on the 16th inst., Dr. Ratcliffe, F.R.S., was the lecturer, and dealt in a most interesting manner with the evolution of the aeroplane. He pointed out how many people tried to imitate the bird by flapping wings, and in this connection he showed a series of fifty photographs, showing one beat of a fly's wings from start to finish. He went on to show that the soaring flight of birds offered another solution and mentioned the long distances which the albatross can soar without moving its wings.

FLYER SILHOUETTES FROM OLYMPIA.

HUMBER BIPLANE.



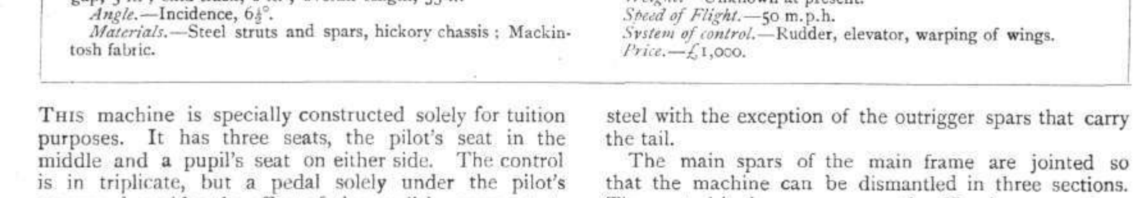
Leading Particulars of the Humber Biplane.

General Dimensions.—Areas—Main planes, 482 sq. ft.; elevator, 16 sq. ft.; rudder, 12 sq. ft.
Lengths.—Span, 40 ft.; chord, 6 ft. 8 in.; camber, $3\frac{1}{2}$ in.; gap, 5 ft.; skid track, 6 ft.; overall length, 33 ft.
Angle.—Incidence, $6\frac{1}{2}°$.
Materials.—Steel struts and spars, hickory chassis; Mackintosh fabric.
Engine.—50-h.p. Humber.
Propeller.—Humber; diameter, 6 ft. 11 in.; pitch, 3 ft. 6 in.; material, laminated mahogany, spruce and walnut.
Weight.—Unknown at present.
Speed of Flight.—50 m.p.h.
System of control.—Rudder, elevator, warping of wings.
Price.—£1,000.

THIS machine is specially constructed solely for tuition purposes. It has three seats, the pilot's seat in the middle and a pupil's seat on either side. The control is in triplicate, but a pedal solely under the pilot's command enables the effect of the pupils' movements to be suspended. All main spars and struts are of tubular steel with the exception of the outrigger spars that carry the tail.

The main spars of the main frame are jointed so that the machine can be dismantled in three sections. The control is the same as on the Humber monoplane designed by Capt. Lovelace.

MULLINER MONOPLANE.



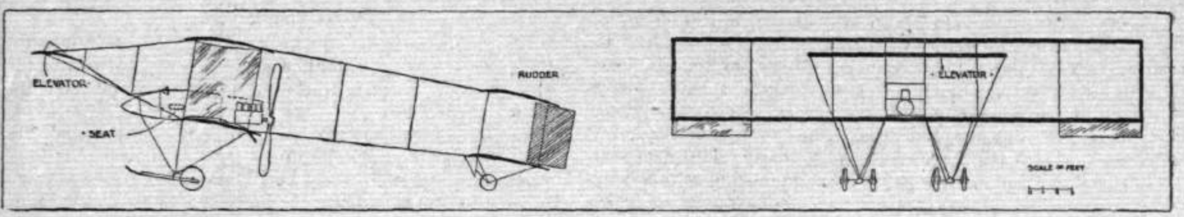
Leading Particulars of the Mulliner Monoplane.

General Dimensions.—Areas—Main planes, 210 sq. ft.; fixed tail, 13 sq. ft.; elevator, 14 sq. ft.; rudder, 4 sq. ft.
Lengths.—Span, 33 ft.; chord, 6 ft. 6 in.; camber, 3 in.; skid track, 4 ft. 2 in.; overall length, 27 ft.
Angles.—Incidence, 10°; dihedral, nil.
Materials.—Timber: ash throughout, few parts poplar; Dunlop fabric, single surface.
Engine.—35-h.p. J.A.P., 8 cylinders.
Propeller.—Spencer; diameter, 6 ft. 3 in.; pitch, 4 ft. 6 in. material, white wood.
Weight.—Machine, 190 lbs. (approx.); engine, 215 lbs.; driver, oil, petrol, water, 200 lbs.; total flying weight, 605 lbs. (approx.); loading (all weight supported on main planes), 2.8 lbs. per sq. ft.
Speed of Flight.—40 m.p.h.
System of Control.—Warping of wings, elevator and rudder.
Price.—£500.

NEW British-built monoplane of very light construction, designed by Gordon Stewart, and built at the Northampton factory of Messrs. Mulliner, the well-known coachbuilders. The design is mainly remarkable for the skeleton-like frame that has been adopted, and the high finish of the workmanship. There are some parts, however, that we shall expect to see strengthened within a short while of this machine commencing its practical trials. The main planes have a comparatively flat camber, and there is even a tendency to reverse the curvature at the trailing edge. The wings are built up upon two main spars, the rear pair of which are hinged together to facilitate warping, which operation is performed by an inclined steering-wheel. The engine is carried right forward in front of the leading edge, and the pilot's seat is situated about two feet behind the trailing edge of the main planes. The machine is supported upon a pair of wheels mounted in a hinged rhomboid or diamond-shaped frame, across the centre of which is stretched an elastic spring that serves for the suspension. The main wings are braced to the "A" extension of the chassis frame, which is constructed of tubular steel.

ZODIAC BIPLANE

(BRITISH AND COLONIAL AEROPLANE SYNDICATE).



Leading Particulars of the Zodiac Biplane.

General Dimensions.—Areas—Main planes, 475 sq. ft.; fixed tail, 50 sq. ft.; elevator, 32 sq. ft.; rudder, $10\frac{2}{3}$ sq. ft.

Lengths.—Span, 33 ft. 3 ins., chord, 5 ft. 11 ins.; camber, 1·88 ins., situated about 18 ins. from leading edge; leverage of rudder, 20 ft. 10 ins.; gap, 5 ft. 9 ins.; skid track, 6 ft. 6 ins.; length over all, 39 ft. 3 ins.

Materials.—Timber, spruce, with certain short struts of ash; fuselage, ash; Zodiac fabric.

Engine.—50-h.p. Darracq.

Propeller.—Chauvière; diameter, 8 ft. 3 ins.

Weight.—Machine and engine, 900 lbs.; driver, oil, petrol, water, 200 lbs.; total flying weight, 1,100 lbs.; loading (all weight supported on main planes), 2·3 lbs. per sq. ft.

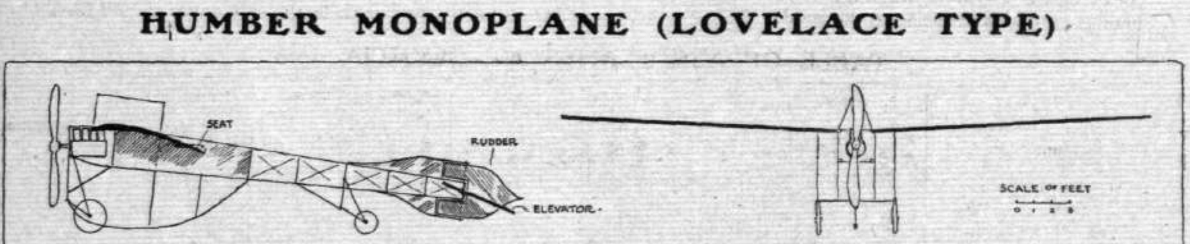
Speed of Flight.—35 m.p.h. at 1,200 r.p.m.

System of Control.—Flaps, elevator, and rudder.

Price.—£1,000.

BIPLANE of the Farman type, characterised by an extremly flat camber to the main planes and by side panels between the extreme struts. There are no panels in the tail. Another interesting detail in design is the chassis. It represents a combination of wheels and skis, but the skis only touch the ground in the event of a very severe shock, and then only the front part of the skids come in contact with the soil. The skids really form pivoted levers, on one end of which the wheel is mounted and to the other end of which the rubber springs are anchored.

HUMBER MONOPLANE (LOVELACE TYPE)



Leading Particulars of the Humber Monoplane (Lovelace type).

General Dimensions.—Areas—Main planes, 210 sq. ft.; fixed tail, 16 sq. ft.; elevator, 16 sq. ft.; rudder, 10 sq. ft.

Lengths.—Span, 33 ft.; chord, 6 ft. 10 ins.; camber, $5\frac{1}{4}$ ins., situated about 26 ins. from leading edge; leverage of rudder, 20 ft.; skid track, 4 ft. 9 ins.; overall length, 26 ft. 6 ins.

Angles.—Incidence $6\frac{1}{2}°$; dihedral, 1 in 11.

Materials.—Oval steel tube struts, hickory chassis, American elm spars in frame from front end to the splice behind pilot's seat, behind which ash spars are used; fabric, Mackintosh.

Engine.—50-h.p. Humber, 4 cylinders.

Propeller.—Humber; diameter, 6 ft. 11 ins.; pitch, 3 ft. 6 ins.; material, laminated mahogany, spruce, and walnut.

Weight.—Weights not known.

Speed of Flight.—50 m.p.h. for loading lift.

System of Control.—Warping of wings, elevator, and rudder.

Price.—£750.

MONOPLANE of modified Blériot design. The peculiarity in the construction of the frame consists in the use of tubular steel struts of oval section. The timber used is hickory, American elm and ash. The machine is mounted on two wheels in front and also has a single rigid skid supported upon three triangular tubular steel struts. The control, which consists of wing warping, elevator and rudder, is effected by a steering wheel, mounted upon a jointed shaft so that the steering column can be moved sideways and to and fro, as well as being turned upon its axis.

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Flight Education in Germany.

THE German Government is preparing an exhibition of models of flying machines, which will be opened in one of the galleries of the Postal Museum in Berlin during the first days of April next. Scale models of the Zeppelin, Gross, Parseval and Republique dirigibles will be found alongside models of the Blériot, Antoinette, Wright, Grade and other aeroplanes, while an exhibit of historic interest will be one of the Montgolfier balloons which were sent up from Paris during the siege of 1871, and fell into the hands of the Prussian Army.

TABLE OF AEROPLANES AT OLYMPIA,

AND SOME OBSERVATIONS ON THE THEORIES OF FLIGHT WHICH MAKE IT INTERESTING.

WE publish this week a table of the aeroplanes at Olympia, wherein will be found the leading particulars relating to each machine. These details we were courteously permitted to obtain by direct measurement in cases where the dimensions required were not known by the representative in charge, but in many instances the designers themselves have supplied the particulars. The data that this table contains are particularly interesting at this early stage of the industry, and we have endeavoured to make the table as complete as possible in respect to those leading dimensions that may be considered as salient in any machine.

Supporting Area.

The first column gives the area of the main planes, which in every case carry the greater part, if not the whole of the weight. Most machines nowadays have a tail, which commonly supports itself in the air, and a proportionate amount of the outrigger on which it is carried. Without knowing the exact basis of the design, however, it is not possible to arrive at values in connection with the action of the tail, and in any case the intensity of its loading is far less than the value that obtains in connection with the main planes. The areas given are the result of multiplying the span by the chord, with allowances for irregularities in contour.

In the second column of the table will be found the areas of the elevators, while the third column contains similar particulars relating to the rudder.

Span and Chord.

The next series of columns relate to the principle linear dimensions. The first of these columns relates to the span (1) or width of the machine regarded from in front. The chord (2) is the fore and aft dimension of the main planes, measured in a straight line between the leading edge and the trailing edge. The fact that this dimension is actually measured along the chord of the arc formed by the cambered section of the plane is sufficient evidence of the appropriateness of the term as a description of that particular dimension, but it is not without interest to remark that it was, comparatively speaking, a long time before we had the "happy thought" that brought this word into use. Up to that time the dimension had always been referred to as the fore and aft dimension of the main plane; a clumsy definition that it was obviously essential to simplify for everyday use. It has been suggested that the dimension should be called "fore-aft," but although the derivation of such a term is obvious, we do not see that it has any advantages over the term that we now use.

Aspect Ratio.

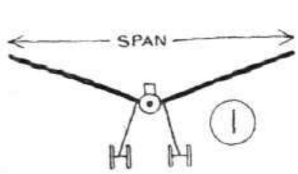
Dividing the span by the chord gives the aspect ratio of the planes, and the higher the aspect ratio the greater should be their lifting efficiency. The reason why aspect ratio is important is because the air that spews out laterally over the side edges of the planes represents loss, consequently the length of the side edges should be kept

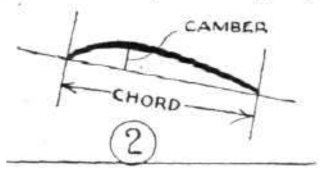
TABLE OF AEROPLANES AT OLYMPIA, 1910.

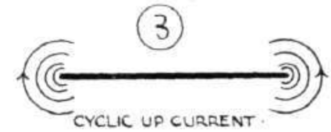
Name.	Type.	Areas. Main Planes.	Areas. Elevator.	Areas. Rudder.	Lengths. Span.		Chord.		Aspect Ratio.	Camber.	Camber Coeff.	Gap.		Skid Track.		Length O.A.		Angles. Incidence.	Angles. Dihedral.	Screw. Diameter.		Pitch.		Pitch Coeff.	In Flight. Weight.	In Flight. Loading.	In Flight. Speed.	Price, including Engine.	
		sq. ft.	sq. ft.	sq. ft.	ft.	in.	ft.	in.		ins.	%	ft.	in.	ft.	in.	ft.	in.	°	1 in	ft.	in.	ft.	in.		lbs.	lbs. per sq. ft.	m.p.h.	£	h.p.
Avis (Aeroplane S. Co.) ...	M	160	15	9	28	0	6	6	4·3	4	5·1	—		4	0	27	0	9	26	6	0	—		—	630	3·9	35	490	25 Anzani.
Avroplane (A. V. Roe & Co.) ...	T	246	74¼	7	26	0	3	6	7·5	1½	3·6	3	3	6	0	24	6	4	22	8	0	3	0	·375	550	1·7	40	600	35 Green.
Blériot	M	193	18	5½	28	8	6	8	4·3	5	6·3	—		5	0	24	9	9	—	6	7	—		—	660	3·4	40	480	25 Anzani.
George and Jobling	B	325	38	25	30	0	5	6	5·5	3½	5·3	5	0	4	9	30	0	9½	—	9	0	10	0	1·22	862	2·6	48	—	60 Green.
Gregoire-Gyp (Fiat)	M	244	20	8¼	34	0	7	4	4·7	4½	5·1	—		5	6	34	0	6° 40′	—	7	0	—		—	820	3·4	45	850	40 Gregoire-Gyp
Handley Page	M	150	6	6	32	6	6	0	5·4	2¼	3·5	—		6	0	20	6	6	—	6	6	3	6	·55	450	3·0	35	375	20–25 Advance
Henry Farman	B	450	27½	17	34	8	6	6	5·4	4½	5·8	6	0	8	8	43	0	—	—	8	0	4	9	·62	1050	2·3	55	1050	50 Darracq
Humber, Le Blon type... ...	M	186	11	5	29	2	6	10	4·3	4¼	5·2	—		4	5	24	0	—	—	6	11	3	6	·5	—	—	—	480	30 Humber
Do. Capt. Lovelace type	M	210	16	10	33	0	6	10	4·6	5¼	6·4	—		4	9	26	6	6½	11	6	11	3	6	·5	—	—	50	750	50 Humber
Do. Biplane	B	482	16	12	40	0	6	8	5·9	3½	4·4	5	0	6	0	33	0	6½	—	6	11	3	6	·5	—	—	50	1000	50 Humber
Lane, 1-seater (Lane's B.A., Ltd.)	M	195	18	5½	30	0	6	6	4·6	4¾	6·1	—		6	0	22	0	—	—	7	0	3	6	·5	650	3·3	30	500	25 N.E.C.
Do. 2-seater (Lane's B.A., Ltd.)	M	250	25	7	32	0	7	10	4·1	7¼	7·7	—		6	0	22	0	—	38	8	8	4	6	·51	970	3·9	30	800	60 N.E.C.
Mulliner (Mulliner)	M	210	14	4	33	0	6	6	5·1	3	3·9	—		4	2	27	0	10	—	6	3	4	6	·71	605	2·8	40	500	35 J.A.P.
Nicholson (Holland & Holland)	M	227	18	5½	32	6	7	0	4·7	5	6·0	—		4	7½	32	0	9	36	6	8	—		—	800	3·5	—	550	25 N.E.C.
Ornis (Lascelles)	M	160	10	5	28	0	6	0	4·7	3	4·2	—		4	6	—		—	90	8	0	3	0	·37	600	3·8	30	450	35 Lascelles
Petre (Leo Ripault)	M	195	36	7	30	0	7	0	4·0	3½	4·2	—		4	9	29	0	—	—	7	0	3	4	·48	740	3·8	30	800	35 N.E.C.
Santos Dumont (A. Clement) ...	M	108	12	7	18	0	6	6	2·8	3	3·8	—		3	0	21	0	7	11	6	6	2	6	·38	530	4·9	40	300	32 Clement
Do. (Mann & Overtons)	M	128	16	6½	18	4	7	0	2·6	3¼	3·9	—		3	8	20	0	—	—	6	6	—		—	536	4·2	45	300	30 Anzani
Do. (Aeroplane S. Co.)	M	143	7½	5	22	0	6	6	3·3	2¾	3·5	—		4	3	26	0	—	—	6	7	3	0	·45	465	3·2	56	320	30 Dutheil-Chalmers
Short (1910) (Short Bros.) ..	B	282	55	10	31	8	5	4	6·0	3¼	5·1	4	4	4	6	31	0	—	—	7	6	—		—	857	3·1	45	650	35 Green
Do. (Moore-Brabazon) ..	B	450	45⅓	7⅔	48	8	6	6	7·5	4	5·1	6	8	—		—		3	—	9	0	—		—	—	3·3	45	1500	
Short-Wright (Short Bros.) ...	B	515	84	23	41	0	6	8	6·15	—	—	6	2	5	8	29	0	—	—	8	6	—		—	—	—	—	—	
Sommer (Hon. C. S. Rolls) ...	B	456	45	9	34	0	6	8	5·0	4	5·0	6	0	9	0	—		—	—	—		—		—	—	—	—	—	
Spencer-Stirling (Berliet Motors)	M	200	19	6	34	0	6	0	5·6	3	4·2	—		5	0	27	0	10	17	6	6	10	0	1·6	850	4·3	40	650	40 R.H.
Star	M	290	20	20	42	0	8	0	5·3	4	4·2	—		5	0	32	0	8	13	6	6	3	9	·58	950	3·3	36	450	40 Star
Twining (Twining A. Co.) ..	B	252	25	6	28	0	4	6	6·1	4½	8·3	5	0	4	0	14	7	7	24	6	3	4	6	·71	450	1·8	35	350	20 Phœnix
Warwick Wright	M	160	14	6	27	0	6	6	4·2	4½	5·8	—		4	0	29	0	9	24	6	0	2	3	·37	605	3·8	35	630	40 E.N.V.
Zodiac (British & Colonial Co.)	B	475	32	10¾	33	3	5	11	5·5	1·88	2·6	5	9	6	6	39	3	—	—	8	3	—		—	1100	2·3	35	1000	50 Darracq

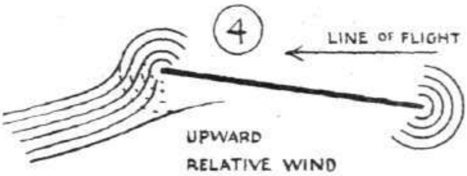
NOTES.—*Types:* B = biplane; M = monoplane; T = triplane.
Blériot monoplanes were shown by L. Blériot, Blériot, Ltd., and the Aeroplane Supply Co.

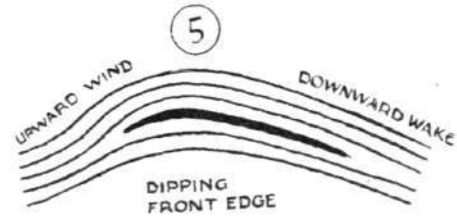
short in proportion to the length of the front and rear edges; in other words, the span should be relatively large in proportion to the chord, *i.e.*, the aspect ratio should be large. It is on account of the value of aspect ratio that an aeroplane flies broadside on instead of end on. It is not known how far high aspect ratios might be used with effect, but it is certain that the highest practical values are reached before theory would suggest the limit. It is difficult to construct machines having very high aspect ratios so that they shall be sufficiently strong and light for aviation purposes. It is also due to the value of high aspect ratios that the biplane and the triplane exist as types. It would be just as easy—in fact, easier—to make a monoplane with as large a surface as any biplane ever built, but it would be well-nigh impossible to make such a machine with the same aspect ratio. When a large surface is required it is necessary to split it up into two or more sections—that is to say, to build a biplane or a triplane. With a triplane it is even easier to obtain a high aspect ratio than with a biplane, and it will be observed on reference to our table that the Roe triplane has the highest aspect ratio of any machine, with the exception of the Short biplane owned by Moore-Brabazon, which is a very much larger machine altogether. The least aspect ratio is to be found in the little monoplane of the Santos-Dumont type.











Camber and its Purpose.

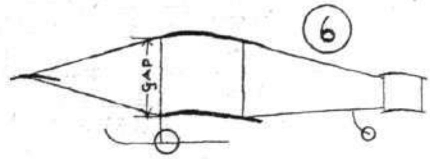
The fourth column in the table devoted to lengths is headed "Camber" (2) and the term has been used to define the dimension that in correct terminology should be expressed as the "maximum versine of the curvature of the fore and aft section of the plane." In other words, it is the maximum height above the chord of some point upon the lower surface of the plane. The term "versine" not being generally in use outside geometry and mathematics, whereas the term camber is an ordinary dictionary word, it is obviously more convenient to use camber in this connection. The values of the camber on different machines are, as will be observed, rather varied. The least is the amount on the Avroplane, but since the camber should always be considered in relationship to the chord, which is a small dimension on this machine, the amount of the camber does not represent such a flat plane in this case as on the Zodiac biplane, where the degree of flatness is quite remarkable. The camber coefficients in the next column, which show the camber as a percentage of the chord, show the relative flatness of the planes at a glance.

Aeroplanes are cambered because the lifting efficiency of the cambered plane has been found to be very much greater than the lifting efficiency of a perfectly flat plane inclined to the line of flight, and the reason that it should be so is not difficult to appreciate, although it is often misunderstood. One inseparable consideration that must be taken into account in connection with the cambered plane is the theory of the dipping front edge. An aeroplane does not fly with its leading edge tangential to the line of flight, as some people suppose, but has its leading edge dipping down so as to be tangential to a relative upward wind. This relative upward wind actually exists as the result of what is known as the "cyclic up-current" in the vicinity of the leading edge. If a flat plane be dropped face downwards through the air, the air will be caused to spew out around the edges of the plate (3). As the plate falls, the air in the vicinity of the edges will flow upwards from beneath the plate in order to make good the displacement, or tendency to create a vacuum, that occurs in the wake of the plane. There is thus a transference of air from beneath the plate to the space above the plate always going on while the plate is in motion through the air, and it is obvious that this cyclic up-current exists whether the plate be falling to earth or traversing the air in any other direction. It exists in the inclined aeroplane, and being compounded with the horizontal motion of the plane itself, creates a relative upward wind in the immediate vicinity of the leading edge (4). If, therefore, it is desired that the aeroplane shall receive the air without shock, then it is obvious that the aeroplane must fly with a dipping front edge (5). In this position the aeroplane meets the relative wind tangentially, and as it is driven onward through the air its camber converts the upward wind into a downward stream in the wake. In effecting this reversal of direction the aeroplane has exerted a downward force that, by Newton's law, exerts an equal and opposite upward reaction. This is how the aeroplane develops its lift or capacity for supporting itself in flight.

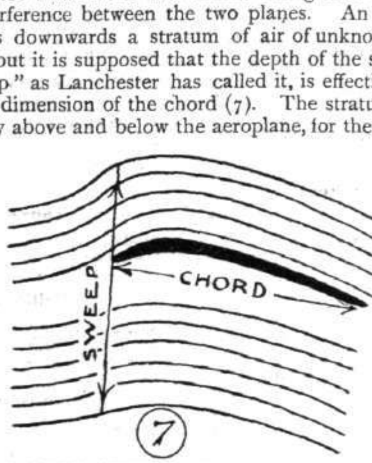
The Gap and why it is Equal to the Chord.

The fifth column in the table of lengths contains dimensions relating to the gap of multiplanes (6). The gap is the vertical height between one plane and that which is immediately above it. It will be observed that the gap is in most cases approximately equal to the chord. It is not really known quite how small a gap may be used in a biplane or triplane, but such evidence as exists, points to the conclusion that it should be

approximately the same dimension as the chord, and this is common practice at the present day. Merely from a constructional point of view it would be advantageous,



especially on large machines, to have a small gap, but if the gap is too small there is a loss of lifting efficiency, owing to interference between the two planes. An aeroplane sweeps downwards a stratum of air of unknown dimensions, but it is supposed that the depth of the stratum, or "sweep" as Lanchester has called it, is effectively equal to the dimension of the chord (7). The stratum extends equally above and below the aeroplane, for the air follows



SWEEP = CHORD

the contour of the upper surface just the same as it follows the contour of the lower surface. If, therefore, a biplane is made with a gap equal in dimension to the chord, it may be assumed in the light of present knowledge, or shall we say absence of knowledge, that there is no serious interference nor consequent loss of efficiency.

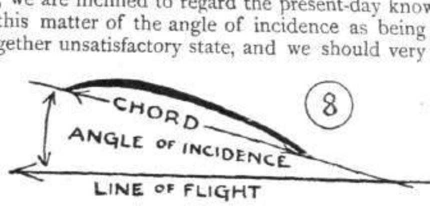
Skid Track.

The skid track for which dimensions are given in the last column but one of those devoted to lengths is an important dimension of an essentially practical character. It corresponds to the track of the wheels on a motor car, but with the difference that whereas the motor car is a fairly compact machine with a considerable amount of natural stability, the aeroplane is very top-heavy at the best of times and is always wanting to fall over, even on land. Too little attention has, in our opinion, been paid to this dimension in the design of several of the aeroplane chassis, but, on the other hand, there are also many examples of machines that have a good firm tread upon the earth.

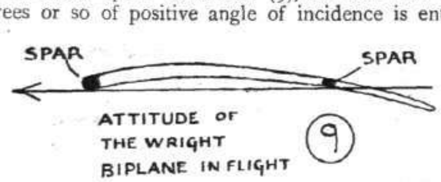
The last dimension given in the column of lengths is the overall length of the machine, which, taken in conjunction with the span, indicates the approximate size of the hangar or shed that is required as a housing.

Angles of Incidence and Deflection.

The next series of figures relate to the angles, and have been somewhat difficult to obtain, nor do we make any great claim for their accuracy. The angle of incidence (8) is the angle that is made by the chord to the line of flight, and in modern machines it seems to have a positive value varying between 3 and 10 degrees. It is less in biplanes than in monoplanes, owing to the relatively large area of such machines. For our own part, we are inclined to regard the present-day knowledge on this matter of the angle of incidence as being in an altogether unsatisfactory state, and we should very much



welcome some really reliable data on the subject. From what we have said above about the dipping front edge, it will be observed that there is no need to have a positive angle of incidence at all, in order to get a lifting reaction from a cambered aeroplane. On the other hand it appears that some positive angle is regarded as contributing to stability, and there is reason to suppose that such is the case. It is, for instance, very instructive to bear in mind that the Wright biplanes fly with their fore and aft main spars horizontal (9), so that the three degrees or so of positive angle of incidence is entirely



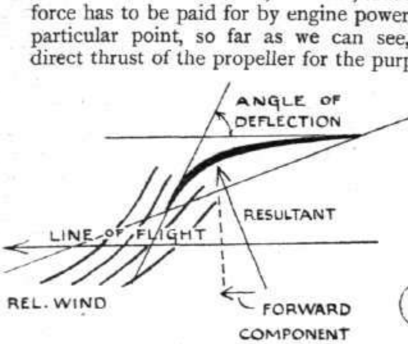
obtained with the trailing portion of the plane that projects behind the aft main spar.

We have taken this opportunity of drawing particular attention to the subject, because it is likely to come in for a very considerable amount of discussion in the near future. We observe, for instance, in the model section, an exhibit, by W. F. Howard, of a monoplane designed to fly with a negative angle of incidence of the chord, in connection with which it has been sought to demonstrate a certain theory of vortex motion. We do not wish to discuss this vortex theory, but we do wish to draw attention to the fact that a negative angle of incidence to the chord is not necessarily at all the same thing as a negative angle of incidence with a flat plane.

It seems to us that the effective angle is that represented by the angle of deflection (10), that the stratum of air is caused to "bend" in order to create the lifting reaction whereby the machine is supported in flight. It is obvious that an aeroplane having a dipping front edge and a horizontal trail (10) would have its chord at a negative angle in flight. If, as the result of actual experiment, it were proved that an aeroplane were more efficient when its leading edge were dipped down so much more than its normal position that its trail became horizontal, then we should be inclined to assume this evidence primarily as an indication of the presence of an upward trend in the relative wind having a steeper slope than had been supposed. We imagine that anyone conducting such experiments would immediately increase the fore and aft dimensions of the plane in order to again deflect the trailing edge without altering the leading edge, because it would seem evident that the full opportunity for obtaining reaction by deflection of the air has not been taken if the aeroplane has a horizontal trail.

A cambered aeroplane arranged with a negative angle of chord would presumably have a resultant pressure inclined forward of the vertical, which would produce a

horizontal component of thrust in the direction of flight. It must be borne in mind, however, that such a favourable force has to be paid for by engine power, and there is no particular point, so far as we can see, in utilising the direct thrust of the propeller for the purpose of indirectly



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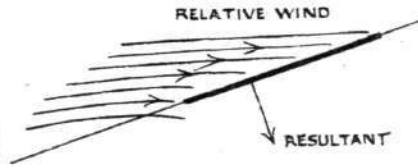


recreating another forward thrust in the aeroplane. The purpose of the propeller thrust is to overcome resistance, which is essentially a retarding force and is made up of two factors, the aerodynamic resistance that provides the vertical lift, overcoming the force of gravity, and the direct resistance represented by the skin friction of the struts, planes and spars.

Laws of Flight Resistance.

It may be of interest while dwelling on this subject to recall the laws that govern these resistances. For a given weight supported, the aerodynamic resistance varies inversely as the square of the speed, while the head resistance varies directly as the square of the speed. The reason why the aerodynamic resistance varies inversely as the square of the speed is because the angle of incidence varies inversely as the square of the speed, and because the aerodynamic resistance is proportional to the product of the angle and the weight. In other words, if the speed of flight be doubled, the aerodynamic resistance will be reduced to a quarter of its former value.

Now it is most important to bear in mind that this law applies to aerodynamic resistance alone, and that it has no meaning whatever unless taken in conjunction with the law of direct resistance. This law, as mentioned above, states that the head resistance varies directly as the square of the speed, consequently the faster the machine flies the greater will be the power expended on this resistance.

Langley, the renowned American investigator of aerodynamics, seems to have regarded skin friction as negligible, and to have been under the impression that the inverse law relating to aerodynamic resistance could be accepted by itself; at any rate, his published statements certainly imply that the higher the speed the less the power required.

It is quite easy to understand, however, that it is only economical to reduce the aerodynamic resistance to an amount that is determined by the relative head resistance, because, when two factors obeying absolutely opposite laws have to be taken simultaneously into consideration, there is one value for each, and one value only, that produces a minimum sum in combination. The great problem that confronts the designer of an efficient aeroplane is the selection of angles, areas and dimensions of struts, so that the total resistance of the machine in flight shall be the least possible for the load supported.

The Dihedral Angle Problem.

Reverting again to the table, which forms the basis of our present remarks, the next column to come under consideration is that representing the dihedral angle made by the wings of many of the monoplanes. A dihedral angle is an angle made by two surfaces that do not lie in the same plane. In respect to aeroplanes, it might be described as the V-setting of the wings. Its purpose is to endow the machine with a certain amount of natural lateral stability, and the theory, or, rather, theories, associated with the dihedral angle, formed the subject of a most interesting correspondence in FLIGHT last year. In our description of the A n t o i n ette monoplane (FLIGHT, Vol. I, p 662), which was the first of the monoplanes to have the dihedral angle in a very marked degree, we sought to explain the theory of natural stability associated therewith by means of simple diagrams.

These diagrams are again reproduced, and as we have seen no cause to change our original theory, we will again put forward the same explanation. The air pressure on an aeroplane is assumed to be normal, *i.e.*, perpendicular to its surface, hence in the accompanying diagrams the lines, P, represent the air pressures on each wing separately. These pressures are inclined from the vertical, but they produce, by the ordinary laws of component forces, two vertical components, P^1, that are sufficient to overcome the force of gravity and support the machine in flight. When the machine is canted over, as shown in the lower diagram, where the right-hand wing is represented in a horizontal position, the full value of P acts vertically upwards on the right wing, whereas the vertical components, P^1, of the pressure on the left wing is reduced. The values of P, however, are still equal to one another on both wings. Now, if the machine were pivoted upon an axis *fixed in space*, the mere fact that the two values of P remain unchanged would be sufficient to keep the machine in equilibrium in any position and would therefore prevent a restoration to the attitude represented in the first diagram. A flying machine, however, does *not* proceed along a *fixed axis* in space; it can rise or fall as a whole, and this fact causes the lower diagram to represent an unstable condition embodying a couple tending to restore the machine to its original attitude.

The canting of the machine has not shifted its centre of gravity, C.G., which, for convenience, is assumed to be situated at the junction of the wings, and consequently it has not altered the proportion of the load carried by each wing. It will be observed, therefore, that the upward force on the right wing is superior to the load it has to carry, whereas the upward force on the left wing is inferior to its load. The result is obvious; the right wing will lift a little and the left wing fall until the loads and the lifts are again balanced. It is not necessary, nor is it probable, that this restoration of equilibrium takes place through an axis passing through the centre of gravity; it is quite likely that the centre of gravity falls a little through space in the operation.

In the table we have, for convenience, given the amount of the dihedral angle as a slope of 1 in "X." It will be noticed that there is a considerable difference in the values.

The Diameter and Pitch of Propellers.

The next series of figures in the table relate to the propeller, or tractor screw, as the case may be. A tractor

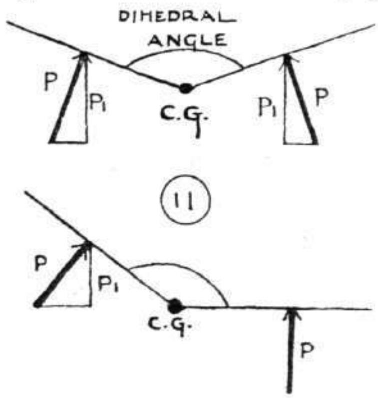
screw is merely a propeller situated in front of the machine so that it pulls instead of pushes. Most monoplanes have tractor screws, and the pros and cons of the arrangement were discussed in our article on the Olympia Show last week.

The first column of figures relating to screws in the table gives the diameters of the various propellers, and it will be observed that there is not a great deal of variation in these dimensions. The next column gives the pitch, but it has not always been possible to obtain this value, owing to the fact that it cannot be readily measured. The pitches given in this column are those represented by the angle of the blade. If, for instance, the pitch is given as 3 ft., it means that the machine would advance 3 ft. through the air per revolution of the propeller (12), if the propeller blade were mounted in *solid* guides, so that there was no possibility of slip. The air is not solid in this way, however; it is, in fact, only capable of offering an abutment for the thrust of a propeller by virtue of being accelerated backwards in the form of a rearwardly moving stream. This stream is called the "slip," and it represents a percentage (in the order of 30 per cent.) of the pitch, so that the machine does not advance through the air by the full amount of the angular pitch per revolution of the propeller.

The Value of the Pitch Coefficient.

The third column of figures relating to the screws in our table gives values of the pitch coefficients, which are obtained by dividing the pitch by the diameter. In most cases it will be observed that the pitch is in the order of one-half the diameter, but that in one or two cases the pitch is greater than the diameter; in other words, the pitch coefficient exceeds unity. The pitch coefficient is a very important factor in the efficiency of a propeller, and marine experience has taught designers of propellers for that purpose that a pitch coefficient in the order of unity should be obtained even with high-speed propellers (See FLIGHT, Vol. I, page 35c). Now it is possible in any propeller to have a pitch coefficient of unity if it is desired, but if those propellers that have a pitch coefficient less than unity in our table, were altered to have a pitch coefficient of unity, then they would either have to run at a slower rate of revolution speed or be made smaller in diameter. Those propellers that have a high pitch coefficient in our table are all indirectly driven from the engine through gear reduction mechanism.

The natural high speed of a petrol engine does not, apparently, at the moment permit of the use of a propeller of reasonable diameter with a high pitch coefficient,



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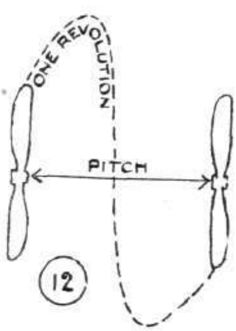

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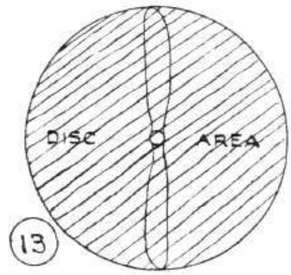


(13)

and it is necessary to have a reasonable diameter in order to get sufficient disc area. The disc area of a propeller (13) is the area included in the circle described by the tips of the blades as they revolve. This disc area represents, approximately, the cross section of the slip stream; in other words, it indicates the mass of air to which rearward acceleration is being imparted. If the mass is large the velocity necessarily imparted to it in order to obtain the thrust required will be small, whereas if the disc area or diameter of the propeller is small the velocity imparted to the slip stream will be high. Now, whereas the power lost in the slip is only directly proportional to the mass of air in motion, it varies as the square of the velocity with which that mass is moving, consequently it is desirable to keep the velocity low by using a large diameter. The best proportion between mass and velocity is given, in the light of marine practice, when the pitch coefficient is unity, but in aeroplane construction the use of a direct driven propeller on a modern high-speed engine would cause the propeller diameter to be unreasonably small with such a coefficient, consequently designers have sacrificed the coefficient rather than the diameter. On monoplanes with tractor screws there is a very good reason for this, too, owing to the large amount of obstruction caused by the body of the machine. If the screw were much smaller in diameter than it is, practically its whole area would be screened in some cases.

The pitch coefficient of a propeller is a factor that indicates the limiting brake angle. If the pitch coefficient of a propeller is unity, for instance, then the boss of the propeller will advance axially an amount equal to the diameter of the propeller while the tip of the blade moves through a path equal in length to the circumference. The ratio of these two movements is one to π, or approximately one to three, which ratio represents the tangent of 18°. This, therefore, would represent the angle made by the tip of the blade to the plane of revolution.

Weight, Loading and Speed.

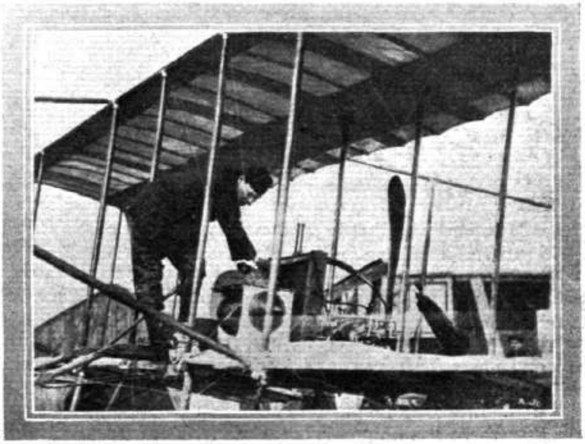
The final series of figures contained in our table relate to weight, loading and speed. The weight given is the weight of the machine in flight and includes in every case an arbitrary allowance of 200 lbs. for the pilot and fuel. Dividing the weight by the area of the main planes, we have obtained the figures given in the column of loading. These figures represent the intensity of air pressure in lbs. per sq. ft. that must be obtained upon the main planes in order to maintain horizontal flight. It has been assumed that the whole of the load is carried on the main planes, except in the case of the Roe triplane, where the tail is definitely constructed

to be a load carrying surface. It is not strictly accurate to omit the supporting effect of the tail in other machines, but it is difficult to give proper value to this factor, and for convenience it has been omitted altogether. It will be observed that the loading values of most of the machines are above 3 lbs. per sq. ft., and go as high as nearly 5 lbs. on the little Santos Dumont monoplane. On the Roe triplane the loading is small, owing to the large surface that is easily available with a triplane and to the lightness of construction in this particular machine. In the Twining biplane the low loading value is due to the small weight of the machine, which in turn is partly caused by the use of a light rotary engine and by the complete absence of a tail. In the Santos Dumont type of monoplane the loading value is high because of the small area. A high loading value implies that it will be necessary to fly very fast, or at a very steep angle of incidence, but the figures that we have been able to obtain relating to the speed in flight are unfortunately of such a character as to make it impossible to deduce any interesting or important conclusions by way of comparison. Much the same remarks also apply to the engine power required for flight, on which we purposely omit to make any observations.

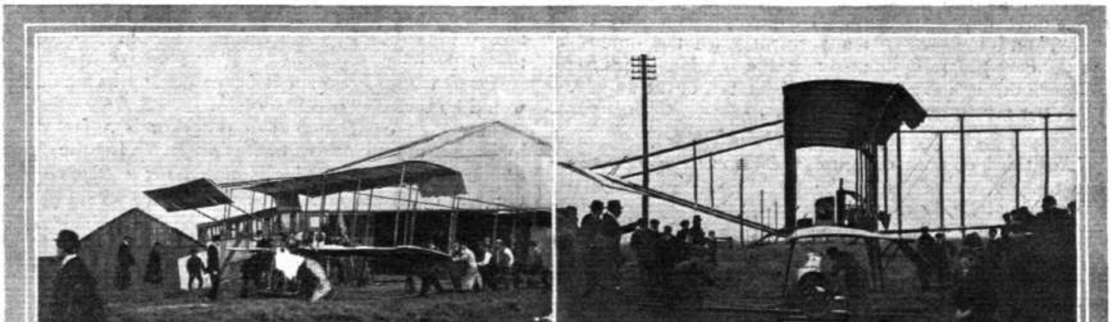
MR. A. RAWLINSON TRIES HIS HENRY FARMAN.

ON Wednesday of last week, a number of people journeyed down to the Handley Page flying ground at Barking to see Mr. A. Rawlinson carry out some trial flights on the Henry Farman biplane on which he recently made some lengthy flights at Chalons Camp. Unfortunately, however, as the machine was travelling across the ground, a wire stay broke, and fouling the propeller, smashed it, necessitating the postponement of the trial until a new propeller could be obtained. The 50-h.p. Darracq motor fitted to the aeroplane has four horizontal opposed cylinders, and during the preliminary tests it gave every satisfaction, so that but for the mishap with the wire stay, trifling in itself, there was every prospect of successful flights being made.

An interesting match is being arranged between Mr. A. Rawlinson and his Henry Farman machine and Mr. J. T. C. Moore-Brabazon on his Short machine, with which he recently won the *Daily Mail* £1,000 prize. It is suggested that they should have a ra[ce] starting from a given point together and flying across country for twenty miles, the first man to be the winner.



Mr. A. Rawlinson tuning up his Darracq engine on his Henry Farman machine.



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Mr. A. Rawlinson and his Henry Farman Biplane at Messrs. Handley-Page's Grounds at Barking.—Bringing out the machine, and, on the right, getting the aeroplane over a dyke to the flying grounds.

Model Awards at Olympia.

MR. CECIL STREETER, general manager of New Things, Ltd., writes us that Mr. M. Jones, whose model (exhibit No. 56) secured a bronze medal, the highest award in the section for toy aeroplanes, which were flown in the presence of the judges in the annexe at Olympia last week, is solely in their Company's employment. Mr. Jones designs and makes these models solely for New Things, Ltd.

Rules of the Air.

AT last the Committee of the Aero Club of France, which has been considering the question of rules of the air, have drawn up a report which has been submitted to the French Minister of Public Works. The chief rules provide that aerial traffic shall keep to a height of not less than fifty metres when passing over buildings; all passing by flyers to be done to the right; aeroplanes at all times giving way to airships; towns not to be passed over except by special permission; all aviators to be examined and licensed, and their machines to bear number plates; all buildings over 150 ft. to show lights at every 50 ft.; names of villages to be painted on roofs of railway stations.

"Flight" Copyright.

The "lighter-than-air" side of the Olympia Flight Show.

AVIATION NEWS OF THE WEEK.

Flying at Eastchurch.

MR. P. GRACE flew from Eastchurch to Leysdown on Sunday last on his Voisin machine and at times reached a height of 100 feet. Unfortunately, on arriving at Leysdown the motor stopped and the machine was slightly smashed in its too sudden descent. On Monday, Mr. Grace was out on his Short-Wright machine and flew for 3½ minutes. The Short-Wright and Sommer machines belonging to the Hon. C. S. Rolls which were on view at Olympia arrived at Eastchurch on Monday morning.

Mr. Haldane on Flight.

SPEAKING at the annual meeting of the British Science Guild at the Mansion House last week, Mr. Haldane said that we had been behind in the science of navigating ships through the air. But a start had been made which, he thought, was full of promise. There was at Teddington, as part of the National Physical Laboratory, an organisation containing architects who had put us, in point of science, at all events, at least abreast of every other nation. It was quite true the ships were not yet built, or very few of them, but they were on their way. Some already existed, and more would exist very shortly. But the point was the organisation had been perfected and brought up to the highest point which experience and knowledge could teach.

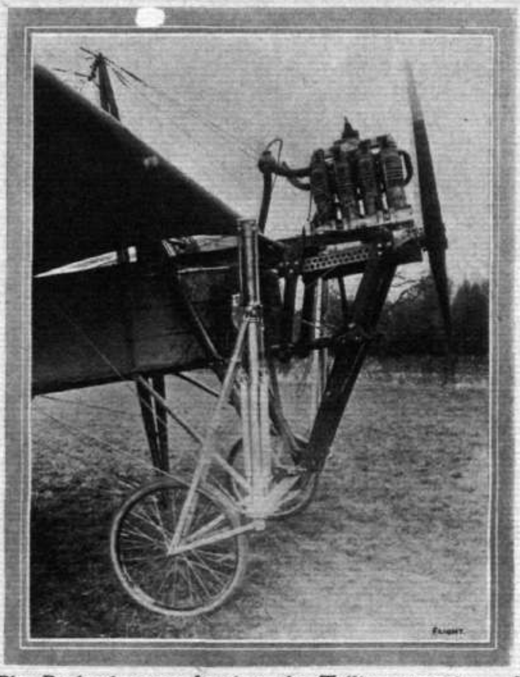
Ae.C.F. Pilote-Aviateurs.

AT their last meeting the Aero Club of France granted a large number of pilote-aviateur certificates, including those to Mr. Moore-Brabazon, Lieut. Calderara, Lieut. Cammerman, Madame de la Roche, Reimsdyck, Morelle, Van den Born, Le Blon, Rene Gasnier, Christiaens, Duray, Jules Tyck, Sands, and Maurice Herbster.

Pilote-aeronaute certificates have been granted MM. Delmas and Leon de Bronckère.

Boat Builders and Aeroplanes.

IN view of the recent tendency in motor boat design towards the hydroplane it is hardly surprising that some builders are turning their thoughts to flying machines. The Tellier works in France, which have turned out some of the speediest motor boats, are responsible for the monoplane seen in the accompanying photographs, and it is being tested by M. Dubonnet, who is famous as a helmsman of racing motor boats. The Tellier monoplane has a span of 11 metres, and the length is the same dimension, while the lifting surface is 24 sq. metres. The



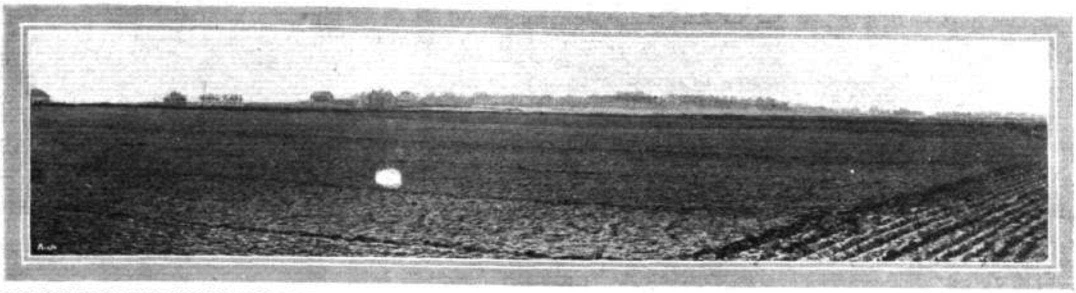
The Panhard motor fitted to the Tellier monoplane. It will be noticed that the engine is carried on a wooden framework, which has all its edges carefully rounded off.

Panhard motor drives a Tellier two-bladed propeller and gives the machine a speed of 70 kiloms. an hour.

Dubonnet a Pilote-Aviateur.

AT its first trial the Tellier monoplane has proved itself an entire success. On the 16th inst. Dubonnet flew

View from the rear of a monoplane which has been built by the Tellier Co., the famous builders of French racing boats. The arrangement of the tail and rudder presents some novel features. It is being tested by M. Dubonnet, another well-known name in motor boating circles.



BOURNEMOUTH JULY AVIATION MEETING.—General view of the flying grounds. A plan of the course appeared in FLIGHT on March 5th.

for 40 minutes at Draveil and on the following day for a quarter of an hour, while on Saturday last he succeeded in making the necessary qualifying flights for his Ae.C.F. certificate as pilote-aviateur.

Rougier at Monte Carlo.

FOR his seventh flight at Monte Carlo, on the 17th inst., Rougier took his usual course to Cap Martin across the sea, and then turning flew at a height of 200 metres towards Nice for some distance, going over the rocks at Monaco to Eze, and then returned after a trip of a quarter of an hour. The next day he arranged to fly to Nice and back, but although he made a good start he found the wind too strong, and therefore returned to his shed. For two minutes he hung in the air without being able to make any advance against the wind.

Mignot at Rheims.

HAVING taken his Voisin to the plains of Betheny, M. Mignot has made some successful flights, and on the 8th inst. he flew for 30 mins., mostly at a height of 15 metres.

Flying at a height of about 30 metres, Mignot on the 16th inst. kept on until he was obliged to come down by the gathering darkness, by which time he had covered about 20 kiloms.

Sommer Getting Busy.

M. SOMMER appears to be gathering quite an extensive school of pupils round him at Mouzon, and they seem to find the handling of this machine particularly easy. On the 14th inst., he gave a lesson to Bouvier, who afterwards flew for 5 kilometres. He gradually progressed, and on the 17th was flying for 20 minutes, most of which was across country. Verstraeten, another pupil of Sommer, has been flying each day. On the 17th M. Sommer gave a first lesson to Legagneux, who has been engaged to fly a Sommer biplane fitted with a Gnome engine, purchased by M. Gremont.

Four Pilots in Eight Days.

AS an instructor, Van den Born would appear to take the palm, for he has added to the honours he has already won by succeeding in training four of his pupils to pass the tests for the Ae.C.F. pilot's certificate in eight days. The four are Jules de Lavine, Count Malynski, who has also been taking lessons on a Wright machine, Nicolas Kinet, and Jules Christiaens.

Doings at Johannisthal.

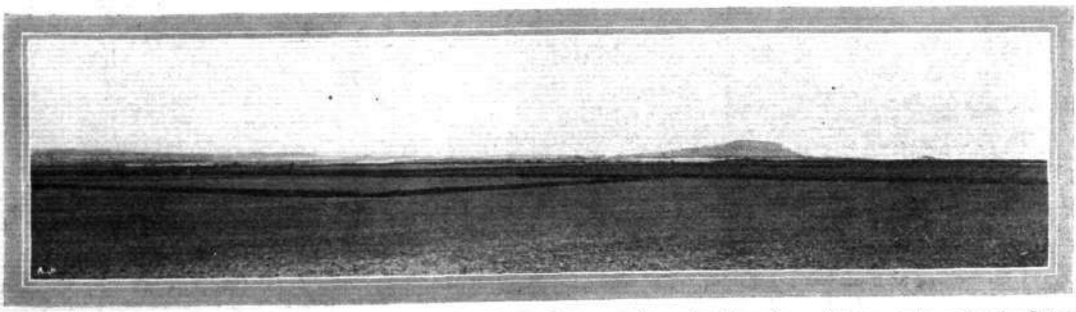
IN addition to Keidel, who made some flights with passengers on his Wright machine on the 18th inst., Brunnhuber succeeded in making a trip of 2 kiloms. on his Antoinette monoplane. Of Keidel's trials, the best was one of 7½ kiloms. in 7 minutes.

Grade at Leipzig.

APPARENTLY the aerodrome at Leipzig, where Herr Grade was giving some exhibition flights on Sunday last, is not all that it might be. After a couple of trials lasting three or four minutes each, Grade started on a cross-country trip, but for some unexplained reason suddenly came down in a forest of fir trees. Naturally the monoplane was badly broken, but Herr Grade himself was unhurt.

Molon at Havre.

AT Havre, on the 16th inst., a large crowd turned out to see Molon fly, and they were not disappointed; for, in spite of the fact that a violent wind was blowing, he flew on his Blériot for 1 hour 4 mins. On the previous day he was flying for 35 mins.



BOURNEMOUTH JULY AVIATION MEETING.—View of the aerodrome looking down the course towards the Solent.

CORRESPONDENCE.

*** *The name and address of the writer (not necessarily for publication)* MUST *in all cases accompany letters intended for insertion, or containing queries.*

Correspondents asking questions relating to articles which they have read in FLIGHT, would much facilitate our work of reference by giving the number of the letter.

NOTE.—*Owing to the great mass of valuable and interesting correspondence which we receive, immediate publication is impossible, but each letter will appear practically in sequence and at the earliest possible moment.*

STARTING AEROPLANES BY MEANS OF ROCKETS.

[417] The necessity of some means of raising aeroplanes quickly from the ground when, owing to engine trouble, they have been obliged to descend on ground not suitable to rise from under their engine-power alone, has reminded me of some experiments I made more than twenty years ago.

I was experimenting with a steam model aeroplane weighing about 30 lbs., and the difficulty was to start it with sufficient velocity on a short plank surface. I had been experimenting with some rocket-propelled torpedoes, and thought I would apply the same system to the aeroplane. The starting was very successful; I wish I could say the same of the subsequent flight.

I propose that a thin steel case, with suitable nozzle, should be fixed to lower side of main frame. The frame should be so supported on its wheels that it is inclined upwards, thus having a greater angle of plane, so that it may rise quickly, besides getting a certain amount of lifting power from the rocket, owing to its inclined position. The orifice of the nozzle should be proportioned to give a suitable recoil, and could be swung open to introduce the charge. Three or four charges could be carried.

The mode of operating would be to drive an ironshod stake into the ground with a light line attached to it, and a slip trigger on the plane. After starting the engine, and when the screw was giving its maximum thrust, fire the rocket and slip the line. I believe the machine would leave the ground in 20 or 30 ft. It would only be necessary for the rocket to burn 8 or 10 seconds. Perhaps Mr. Hudson Maxim's motorite would be a suitable fuel. If the descent was made on ploughed ground it would be easy to kick and trample down the furrows in front of the wheels for a short distance. In standing corn, when ripe, there might be danger of setting fire to it. I don't know what the cost of each charge would be, but I think not more than ten shillings. I expect the first experiments would be rather exciting, but reduced charges could be used. Anyway, I think the idea is worth experimenting with by a man who has got a machine and can fly it.

Oxford. T. J. BENNETT.

A NEW MODEL AND A CHALLENGE.

[418] We have recently designed and completed a model which we believe is, in respect to stability, and certainly of directional control, superior to any other model yet made, and in order to demonstrate the qualities of this machine we should like to challenge, through the columns of your invaluable paper, any model maker to a contest which should adequately test these qualities. We believe that a test of this nature could be best attained by a round of "Flight Golf," on a course reasonably near London, to be fixed on by mutual arrangement or by some independent person—say, the Editor of FLIGHT.

Should any model maker be willing to take up this challenge, but object to the proposed form of the contest, we are willing to consider other methods of testing these qualities, and, failing agreement, to accept any form of contest which shall be decided on by the Editor of FLIGHT as a reasonable test of the qualities which we claim for our machine.

This challenge is issued for elastic or spring-propelled models of not more than 4 sq. ft. of lifting surface, although we propose to enter ourselves a machine of only 1 sq. ft.

W. H. SAYERS.
Mitcham. W. ROWLAND DING.

ADVERTISERS' STATEMENTS.

[419] I am not surprised at Messrs. Bonn taking exception to my advertisements in FLIGHT, March 12th; evidently the boot pinches. It may interest Messrs. Bonn to know that I have proof that they got their cue from me for at least one of the three model fittings claimed in their letter of March 19th. Their claim to be the first makers of these fittings is rather sweeping. I made them years before the name of Bonn was heard of in the aeronautical world.

WILLIAM COCHRANE.

THE DIHEDRAL ANGLE.

[420] When an aeroplane is tilted sideways the resultant force, R, produced by the planes is no longer vertical, but its direction forms an angle with the vertical equal to that through which the machine has moved. This inclined resultant, R^1, can be represented by its vertical component, V, and the horizontal, H. We see, then, that the vertical, or actual sustaining force, has been reduced, and if the original, R, was required to maintain an horizontal flight it follows that the machine must begin to drop. At the same time, however, a lateral motion must take place, due to the horizontal force, H. Now V increases and H decreases as sin. δ decreases, until δ is again $= O$, when also $H = O$ and $V = R$. This means that the whole machine swings like a pendulum round some point, P, whose distance from the centre of the planes bears some definite relation to their sustaining force. This holds good for planes of any shape; but it will be seen that when set at an angle their resistance to this motion will be far less than that of flat planes, as the former lie more nearly in line with the circumference of a circle. In fact, it may be possible to calculate the correct radius, and then obtain the best lateral stability by actually making the planes part of the circumference of a circle with that radius. If this could be done, only the extreme edge of the plane would be presented to the air, as offering resistance to the self-righting movement of the machine.

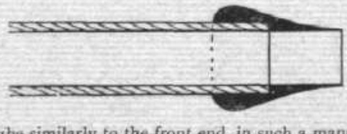
Your correspondent G. E. Page, in your issue of Feb. 5th, shows by his own diagram that he is explaining, not the effect of the dihedral angle, but the effect of placing the weight below the mean of the sustaining surfaces. This can, of course, be done with planes of any shape, but is no more necessary with a dihedral angle than in any other case.

Prescot. J. T. MATTON.

ANEMOMETER.

[421] With your kind permission there are one or two suggestions and remarks I would make with reference to the simple form of anemometer, described by Mr. Norman J. Bowater in the issue of your valuable paper dated November 27th, 1909.

It is not quite clear, I think, what purpose is served by the square piece of wood fitted to the bent end of the tube; but being described as a shield, it is apparently intended to prevent the current of air blowing down the straight end of the tube and exerting a back pressure on the liquid in the tube, which would, of course, render the readings inaccurate. In the position shown, however, immediately behind the mouth of the tube, would it not be likely to set up eddying currents of air within the tube, and so render the readings inaccurate in that way? And would it not rather be desirable to reduce the area of the surface presented to the wind to a minimum in order to avoid the possibility of such interference? This might easily be done, I think, by fitting to the mouth of the tube a metal or wooden ferrule of the shape shown in the attached sketch. The square wooden shield might be secured directly to the straight end of the tube, if necessary. Is it really necessary, however, that this end of the tube should be vertical? Might it not be an advantage, to obviate the use of a shield altogether, by bending the back



end of the tube similarly to the front end, in such a manner that the two ends lie in the same line with each other, but turned in opposite directions?

I would also suggest, as a possible improvement, that the U-shaped tube should be set up on a spindle, turning between centres, and fitted with a directing-vane, in order to ensure that the centre-line of the tube lies truly in the direction of the wind when the reading is being taken.

It would also be interesting to know what means Mr. Bowater has adopted for taking such necessarily accurate readings.

Portsmouth. A. C. H.

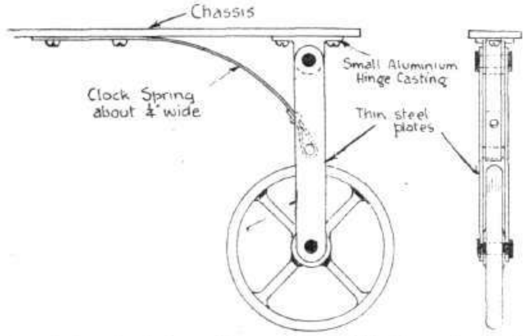
WRIGHT MODELS (279).

[422] I would recommend 2·8 in. propellers for model described by G. Alchins (279). The Cochrane Co. supply flat strip rubber just over ½ in. wide at 1½*d.* per yard; they have also got small cut gear-wheels $\frac{1}{16}$ in. thick for making geared rubber motors, gear ratio 3 to 1, price 6*d.* each.

H. WILLIAMSON.

SUSPENSION FOR MODELS.

[423] I herewith enclose sketch of cheap and effective method



of springing wheels for model aeroplanes, which I have found quite satisfactory. Trusting this will interest your readers.

Manchester. J. DITCHFIELD.

MODEL DESIGNS.

[424] Could you or any of your readers—through FLIGHT—supply me with plans of a model aeroplane?

I want it to be small, cheap, and easy of construction, and so long as it flies I don't mind in the least it not being a "perfect" model.

Great Marlborough Street, W. NULLI SECUNDUS.

AN INDIAN BIPLANE.

[425] We have yours giving us names of motor engines, for which we are much obliged, and in return we are posting you photograph of what we believe is the first aeroplane in India, which has been constructed by one of our customers, a Mr. C. D'Angelis, of Madras. The machine has been built by our friend entirely from his own designs, and we understand that although up to the present he has been experimenting with a small horse-power engine, the results given by this are so satisfactory that with a higher horse-power he anticipates being able to make long and consecutive flights.

E. AND A. LEVETUS AND CO.

Mr. C. D'Angelis' Indian biplane.

SILVER SPRUCE.

[426] Knowing that you are always willing to assist your readers when in difficulties and believing the matter about which I write to be one of general interest, I would be very glad of a little advice and assistance. I wish to procure a quantity of best Oregon or silver spruce, such as is used by the British and American builders of aeroplanes. The Clarke glider is, I believe, built of this wood, and Messrs. Short Brothers use it largely. Can you advise one how to obtain sufficient to build a glider. I ordered some first quality spruce from a timber merchant and the enclosed is a sample of the stuff I received. Would you be good enough to say if this *is* spruce. It appears to be ordinary white deal and I am dubious as to the advisability of using it for my machine. Thanking you in anticipation.

Hanwell. WALTER BIRD.

[We placed the specimen referred to in the above letter before a well-known constructor, who replies as follows:—

"It is apparently an ordinary piece of *white* spruce. This is by no means the same material (although of the same kind) as the silver spruce, of which I use a great deal in all my machines. (I think I was about the first person in England to use it at all three and a half years ago.) White spruce is one of the commonest of woods, and is very stiff, but it is hard to obtain clean in long lengths, and is very liable to warp and go crooked. The best is the Quebec spruce. Silver or silk spruce, on the other hand, can be obtained in planks 30 ft. long without a mark or flaw in them, and beautifully straight; it is of a slightly pink colour, and when planed has a crystalline silky appearance; it is also considerably harder to work with the plane, &c. It comes from Canada (nearly all straight-grained timber comes from the American continent, where the climatic conditions are more regular than on our side). Being considerably more expensive, it is not used much except for special work. Messrs. Voisin Frères have sent over to England for a considerable amount of this wood; they also had some of the shaping for their struts done at my works."

H.P. OF MODEL PETROL ENGINES.

[427] I beg to draw attention to what I think must be misleading ratings of the h.p. of model petrol engines listed by various firms. The engines made at my works—the Hammersmith Model Works—of ½-h.p., have 1¾ in. by 1¾ in. stroke and the ¼-h.p. 1½ in. by 1½ in. stroke at 2,000 r.p.m. Other firms of which we have lists have 1⅛ in. by 1⅛ in. stroke, giving ⅜-h.p., and the ¼-h.p. are 1 in. by 1 in. stroke, the stated power at 1,800 r.p.m. Now a simple formula for rating of engine h.p. is:—

$$\frac{\text{Bore}^2 \times \text{stroke} \times \text{No. of Cylinders} \times \text{R.P.M.}}{12{,}000} = \text{H.P.}$$

One will see that the above engine dimensions are quite wrong as regards power stated. I shall be pleased to hear from readers who have above engines or of similar dimensions whether they have derived full power from their engines or any power at all.

Hammersmith. R. WEICHMAN.

MONOPLANES *V.* MULTIPLANES.

[428] In a recent issue appeared an article entitled Monoplane *v.* Multiplane, by Mr. A. V. Roe, and as one who has watched his experiments, I should like to write in support of his machine.

I think it is more efficient than any of his foreign rivals, having proved its capability of carrying a load of 50 lbs. per horse-power, whereas I believe that the next best results worked out—with a Farman—at under 35 lbs. per horse-power.

Mr. Roe has flown with an engine of less horse-power than anyone else, either at home or abroad, and in this also he deserves credit for working in an original field.

I have been several times to France lately, and have seen all the leading types, yet every visit makes me more enthusiastic about the future of this British-built triplane.

Trusting that you will find room for this appreciation of British enterprise.

C. R. L. KENWORTHY.

[It will be interesting to watch Mr. Roe's progress with his new machines, that are to have 40-h.p. engines in order to be sufficiently powerful to carry passengers.—ED.]

The Ascent of the Aviator.

IN the air one minute—"Another foolish inventor."
In the air three minutes—"Hasn't he killed himself yet?"
In the air five minutes—"All the fools ain't dead yet."
In the air thirty minutes—"Mr. Ayrider, the well-known aviator."
In the air one hour—"Our distinguished fellow-countryman."
In the air one hour and a quarter—"The wizard of the air."
In the air one hour and a half—"The Legion of Honour could have been bestowed on no worthier man."—*London Opinion.*

A Wright Glider.

WE have several times pointed out that it is very helpful for those who are taking up flying to have some experience first with a glider, and in this connection it is interesting to note that the Hon. C. S. Rolls has decided to dispose of the Wright man-lifting glider on which he did a considerable part of his apprenticeship in flight. It is practically a miniature Wright machine without engine. It is complete, with a set of starting-rails, lock-up shed, and the gliding rights of a hill, and anyone interested can get particulars from Mr. Rolls, at South Lodge, Rutland Gate, S.W.

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NEW COMPANY REGISTERED.

Monoplans Hanriot Co., Ltd., 3, East India Avenue, E.C.—Capital £4,000, in £1 shares. Manufacturers of monoplanes, biplanes, and other kinds of aeroplanes. &c. Acquiring the business of René Hanriot, of Rheims, France, manufacturers of the Hanriot type of monoplane. First directors, Comte Guillaume de Noue, L. Duncan-Wagner, R. Hanriot, and A. Manquat.

⊛ ⊛ ⊛ ⊛

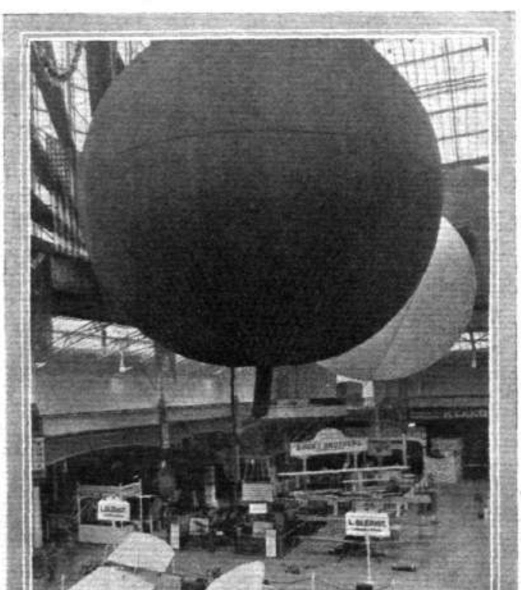
PUBLICATIONS RECEIVED.

The Aeroplane Portfolio. London: Percival Marshall and Co. Price, 1*s.* net.

Catalogues.

"Avis" Monoplane. The Scottish Aeroplane Syndicate, 166, Piccadilly, W.

Aviation Accessories. Brown Brothers, Ltd., Great Eastern Street, E.C., and 15, Newman Street, W.



Prominent in the main hall at the Flight Exhibition at Olympia was the Continental balloon, which formed part of the exhibit of the Continental Tyre Co. Above we give a photograph of the Company's stand.

DIARY OF FORTHCOMING EVENTS.

British Events.

1910.		1910.	
July 11–17	Bournemouth Flight Meeting.	Aug. 6–13	Flight Meeting, place not fixed.

Foreign Events.

1910.		1910.	
April 2–10	Biarritz.	July 14–24	Rheims to Brussels, cross country event.
April 3–10	Cannes.	July 24–Aug. 10	Belgium.
April 10–25	Nice.	Aug. 25–Sept. 4	Deauville.
May 10–16	Berlin.	Sept. 8–18	Bordeaux.
May 14–22	Lyons.	Sept. 24–Oct. 3	Milan.
May 20–30	Verona.	Oct. 18–25	America. Gordon-Bennett Balloon Race.
June 5–12	Vichy.	Oct. 25–Nov. 2	America. Gordon-Bennett Aeroplane Race.
June 5–15	Budapest.		
June 18–24	St. Petersburg		
June 26–July 10	Rheims.		

Aeronautical Patents Published.

Applied for in 1909.

Published March 24th, 1910.

4,624. H. A. SANDERS. Aeroplane.
4,803. C. VAN MOORSEL. Flying machines.
4,812. C. H. A. VERITY. Flying machines.
6,745. L. BLÉRIOT. Cooling of aerial motor.
12,775. J. SCHÜTTE. Airships.
27,673. G. H. M. CANTON AND P. G. UNNÉ. Tubes for aeroplane construction.

BACK NUMBERS OF "FLIGHT."

SEVERAL back numbers are now very scarce, and have been raised in price as follows:—

1909.			*s.*	*d.*
No. 2, Jan. 9,	*containing*	Table of Propellers ...	1	6
3 ,, 16	,,	,, Engines ...	3	0
4 ,, 23	,,	Engines at Paris Salon	3	6
6, Feb. 6	,,	"How Men Fly" ... Aeronautical Bibliography. Wright Bros.' Elevator Patents.	1	0
8 ,, 20	,,	Flying Ground at Fambridge Illustrated Glossary.	1	0
10, Mar. 6	,,	Human Side of Flying ... Aero Club Ground at Shellbeach. Military Aeronautics.	1	0
12 ,, 20	,,	Souvenir Supplement ...	1	6
15, Apr. 10	,,	Engines at Olympia ...	1	0
16 ,, 17	,,	Prize List ... Models at Olympia.	3	6
31, July 31	,,	Blériot Flyer ... (Full page drawing.)	2	0

Other back numbers, post free, $1\frac{1}{2}$*d.* each (including descriptions and scale drawings of the Voisin, Curtiss, Cody and Farman biplanes, the Santos Dumont, Antoinette, and Grade monoplanes, and of a full-size Wright glider.

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